THE REFINER AND NATURAL GASOLINE MANUFACTURER

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Recovering uncondensed still vapors. Research shows how big saving can be made.

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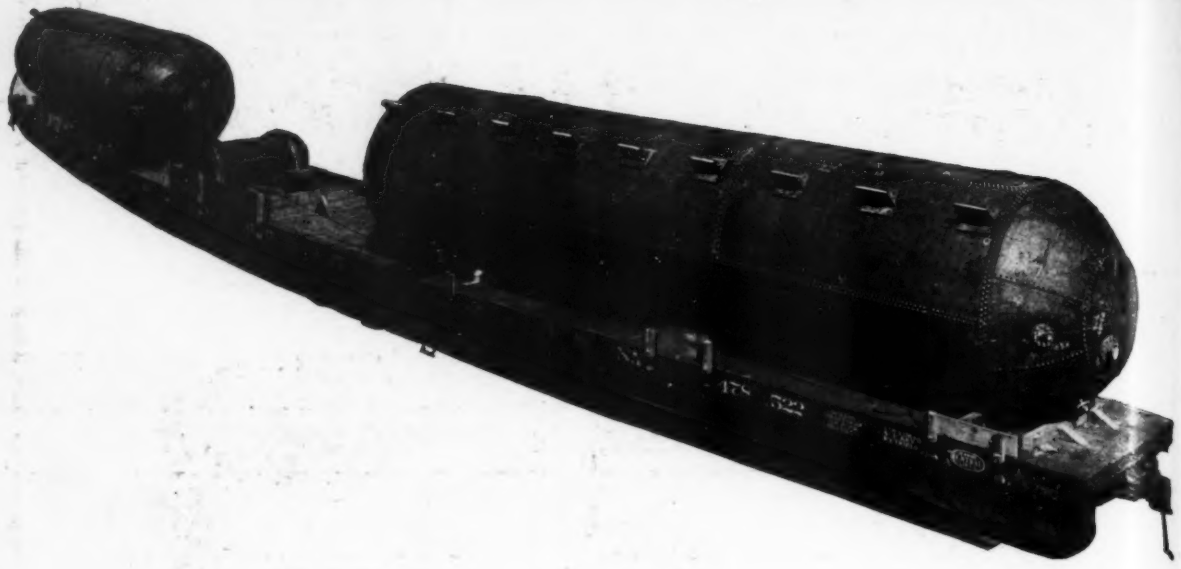

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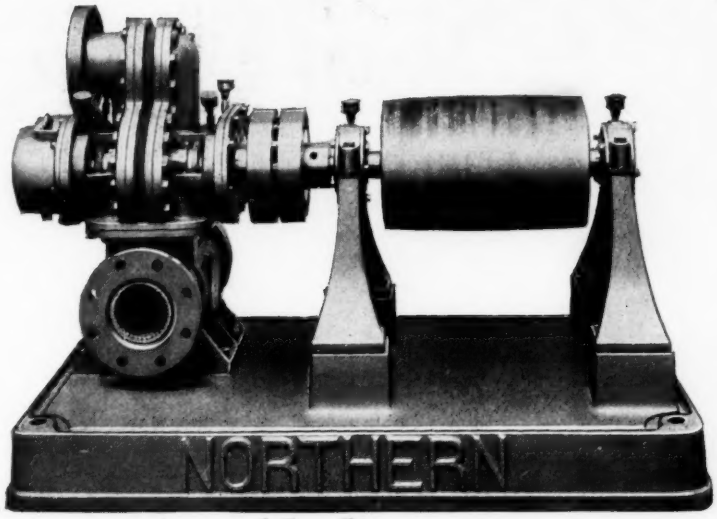

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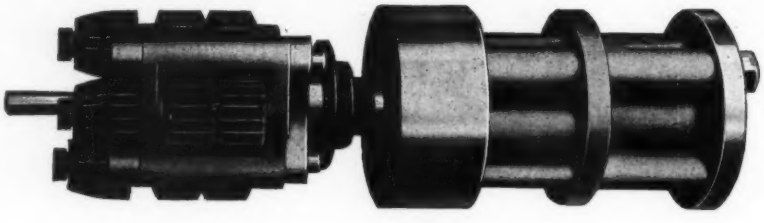

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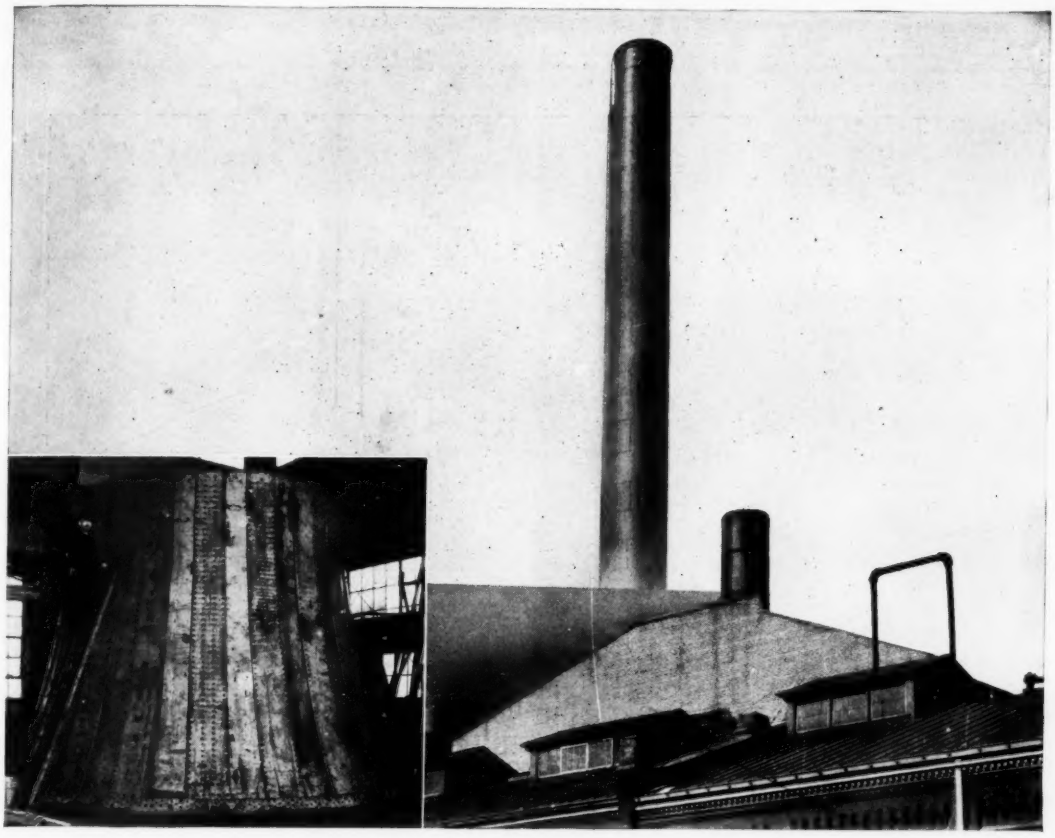

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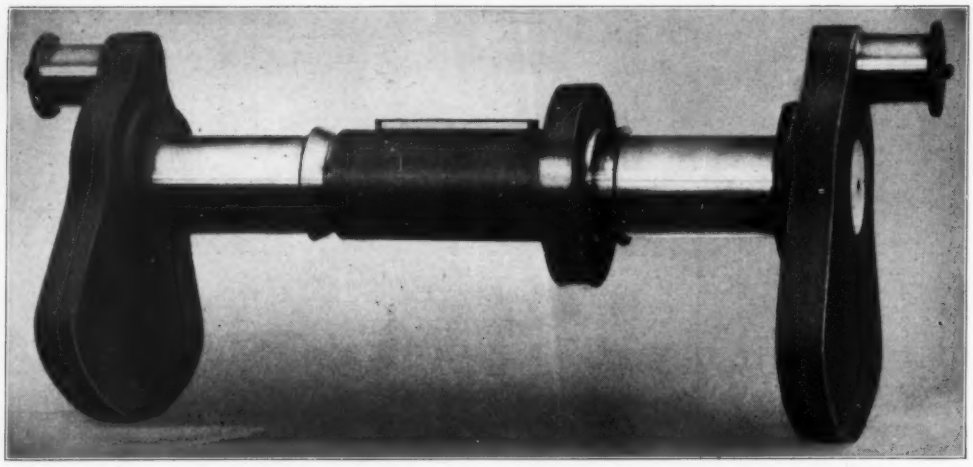

"That Large a Crank Shaft for a 160 H.P. Engine?"

Our visitor, a practical gas engine man, had already commented upon the size of several of our gas engine parts and upon the quality of metal in our castings. "There are some shafts for our 160 H. P. engine," we pointed out.

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R. L. DUDLEY..Manager and Editor

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Gasoline Men Discuss Operating Methods

Round table session brings out many efficiency secrets from plant superintendents

By Spencer W. Robinson
Associate Editor

Tulsa, Oklahoma. — Methods of increasing operating efficiency, lowering production costs with special stress on those efforts being made toward reducing weathering losses, and other subjects of manufacturing technique were uppermost in the minds of those attending the third annual meeting of the Association of Natural Gasoline Manufacturers.

Temporarily disregarding the heritage of precedent as to convention program and policy those attending the two day session here on April 23-24 got down to business with but one motive in mind, and that to get the most out of the meeting and strive toward more scientific operation through the exchange of ideas.

Round Table

The round table discussion, inaugurated at the meeting for the benefit of plant foremen and superintendents, but largely attended by both field men and executives, proved to be the most interesting feature yet staged by the Association.

At this gathering, plant operators from various sections of the country told of their operating experiences, relating troubles encountered and giving the benefit of their research with earnest solicitation for suggestions and recommendations from brother plant men. Many new ideas and views were "aired" that executives admitted they were not aware of in their own plants.

Of particular interest to members attending the annual get-together was the discussion of stabilization or fractionation, at which operating results of the Stabilizing Process now being used by the Tidal Refining Company were described. The result of the discussion was the discovery that many engineers have turned their attention toward this phase of natural gasoline manufacturing and that trouble to the extent of that recently experienced over Cracking Processes can be expected shortly.

It was brought out that The Texas Company has developed a process for use in connection with its West Tulsa refinery and according to W. K. Holmes, general superintendent will be ready to offer it for sale to the industry. Others, while not yet reaching the commercial stage, intimated that efforts were being made extending along these lines.

Other technical discussions of equal value were made and promises of a larger round table session for plant men was offered for the coming fall.

At the business session of the meeting, the association went on record as favoring the action recently taken by other oil trade oragnizations for promoting good will among the public and wipe from the industry the stigma stacked up by recent Senatorial investigations. A resolution to this effect was passed.

Large Attendance

The attendance at the convention this year was far greater than ever before since the organization of the association three years ago, there being a registration of 305, representing individuals and corporations engaged in the manufacturing of natural gasoline.

The welcome address was delivered by Hon. Pay Malloy, receiver for the Constantin Refining Company, followed by the annual address of D. E. Buchanan, vice-president of the Chestnut and Smith Corporation, President of the Association of Natural Gasoline Manufacturers.

Mr. Chas. F. Bevan, of the Pacific Gasoline Company, Los Angeles, California, read an interesting paper on "The Future of the Natural Gasoline Industry in California" at the close of the morning session. Mr. Bevan answered many questions in regard to the industry in California, giving interesting information to the Mid-Continent operators.

Stabilizer

The afternoon session of the first day, over which Emby Kyle, of the Skelly Oil Company officiated, opened with a paper on the "Stabilizer in Operation" read by L. F. Bayer, Manufacturing Manager of the Tidal Refining Company. Taking the advantage of the knowledge of Mr. Bayer in regard to the Natural Gasoline industry, who is regarded as one of the well-informed men of the industry, an interesting discussion took place, lasting over the period of more than an hour, during which time the representatives of the industry learned much in regard to the operations.

D. B. Dow, of the U. S. Bureau of Mines, Experimental Station at Bartlesville, wrote a paper which was read by his assistant, M. P. Youker, on "Recovery of Still Vapors in Straight Run Refineries", which was followed by a lengthy discussion on the subject.

At the business meeting at ten

Some of the 300 gasoline men attending the third annual meeting of the Association of Natural Gasoline Manufacturers held in Tulsa, April 23-24.

R. T. Zook, President of The SLOAN & ZOOK CO.

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A. M. BALLARD
Elected Vice President of the Association of Natural Gasoline Manufacturers for coming year

o'clock on the second day of the convention the following officers and directors were elected for the coming year: D. E. Buchanan was unanimously re-elected as president of the organization, Frank L. Chase, operating manager of the Lone Star Gas Company of Dallas, Texas, and A. M. Ballard, manager of the Sun Company and head of the gasoline plants of the Twin States Oil Company, were chosen as Vice-Presidents.

Directors re-elected include: D. W. Moffit, Cosden Oil and Gas Company; E. L. Peck, Empire Gasoline Company; H. A. Trower, Phillips Petroleum Company; Emby Kaye, Skelly Oil Company; O. L. Cordell, Waite Phillips Company; C. W. Mullalley, Arkansas Fuel Company; H. A. Rafferty, Chemical and Carbide Chemical Company, New York City; Kenyon L. Reynolds, Pacific Gasoline Company, Los Angeles.

New directors are M. E. Mockley, Amerada Petroleum Corporation; John Hall, Oil State Gasoline Company; G. G. Oberfell, Hope Engineering and Supply Company; George S. Ratcliff, Texas and Pacific Coal and Oil Company, Thurber, Texas; W. H. Gray, Tribes Gasoline Company and E. A. Landreth, Landreth Gasoline Company, Breckenridge, Texas.

Hold-over directors are W. M. Welch, Tidal Refining Company; H. R. Owens, Marland Refining Company; L. C. Ritz, Oklahoma Eastern Oil Company; H. R. Johnson, Akin Gasoline Company; A. J. Schlosser, Barnsdall Oil Company; A. M. Jones, Amity Gasoline Company and W. A. Melton, Liquified Petroleum Gas Company.

W. K. Holmes, superintendent of the West Tulsa refinery of the Texas Company spoke on "Natural Gasoline—It's place in the Straight Run Refinery", as an opening address for the afternoon session of the last day. He emphasized the fact that the refinery or the natural gasoline manufacturer could not get along without the other and solicited the undivided unity of the two industries.

"The Relation of the Producer to the Natural Gasoline Manufacturer" was presented in a paper by Ray Short, Superintendent of the Casinghead Gas Division of the Prairie Oil and Gas Company. He stressed the necessity for plant efficiency, better gas contracts, frequent field tests and economic uses of residue gas. Mr. Short was followed by I. P. Parkhurst, Superintendent of the Casinghead Gas Contracts and Sales of the Empire Gasoline Company, who presented a paper on "The Relation of the Natural Gasoline Manufacturer to the Producer". Mr. Parkhurst was very desirous of promoting unity between the two principals included in his subject.

The closing paper of the convention was read by D. B. Dow of the U. S. Experimental Station of the Bureau of Mines at Bartlesville. The subject "The Producer and the Natural Gasoline Manufacturer" was directed to both the producer and the manufacturer in the matter of co-operation for their equal financial betterment, if for no other reason.

D. E. BUCHANAN
again chosen president of the Gasoline Men

The banquet room of the Hotel Tulsa was filled to capacity in the evening, when, for the first time in the history of the association, ladies were entertained with a banquet and dance that followed. D. E. Buchanan was Toastmaster of the banquet and ably presented the principal speaker of the evening, the Honorable Victor Murdock, publisher of the Wichita Eagle and exchairman of the Federal Trade Commission at Washington. Mr. Murdock spoke on "America's Opportunity" in which he pointed out the fact that America was foremost in the four most vital things for human existence, fuels, food, structurals and gold. No one could have been better equipped to tell the story than Mr. Murdock, after his experience in diplomatic affairs.

Mr. Buchanan closed the banquet with a short talk on the Association of Natnral Gasoline Manufacturers, its aims and aspirations and the good it had accomplished in the past.

Magnolia Piping Louisiana Gas to Beaumont Refinery

Beaumont, Texas, May 12.—Pipe and booster station equipment are being purchased by the Magnolia Gas Company of Dallas, Texas, to start work immediately on the construction of a huge welded gas line from Northern Louisiana to Beaumont in order to supply the Magnolia Petroleum Company's refinery with natural gas to replace oil as fuel in the operation of the plant. This line will be approximately 210 miles in length, and will obtain production from the Cotton Valley field, Webster Parish, Louisiana, and from the Panola County gas field in Northeast Texas. Considerable gas production in these two fields is owned by Magnolia Petroleum Company and its subsidiary, the Fortuna Oil Company, while contracts have been made for sufficient additional gas to keep the line supplied with its rated capacity of 65,000,000 cubic feet of gas daily. No announcements have been made as to whether gas production will be sold to Beaumont and other cities and towns located along the proposed line.

Three different sizes of pipe will be used in the gas main, with the greater part being made up of 16 and 18-inch pipe, while 14-inch pipe will be used from the Cotton Valley field to the booster station at DeBerry, located in the Panola County gas field. About 65 miles of 18-inch pipe will be used on the lower end of the line. The pipe joints are to be welded for the full length of the line, and when completed will be one of the largest welded lines in the country.

The Magnolia Gas Company was recently organized under the laws of Delaware with a capital stock of 100,000 shares of non-par value, while a charter to do business in Texas was authorized last week. Headquarters are maintained in the Magnolia Building, Dallas.

A. V. BOURQUE
who has served as secretary for the association since it was first organized has again been selected to hold that office

Savings Effected by Use of Stabilizer

Process in operation at Tidal Refining plants shows production costs can be cut

By L. F. Bayer
*Manufacturing Manager Tidal Refining Co.**

THE information used in this paper on the stabilizer is obtained from our experience in operating an installation at each of the two Burkburnett plants of the Tidal-Western Oil Corporation. The columns were built and erected by the Carbide & Carbon Chemical Corporation under whose patents they were licensed. The first stabilizer was put in operation about the middle of January and the second during the early part of February, 1924. The plants at which they are applied are both of the compression type, operating on the rich casinghead gas which is generally produced in the Burkburnett field.

A refinery is operated by the Tidal-Western Oil Corporation in conjunction with the gasoline plants, at which low gravity gasoline is cut from the crude to meet the desired distillation specifications as regards the 50 per cent, 90 per cent and end points. This gasoline, deficient in its proportion of light fractions, is used at the gasoline plants as a blending material for the natural gasoline, which adds the desired lighter fractions, producing an excellent motor gasoline. As the plant operates on rich gas, the initial extraction before weathering was unusually good and due to the blending material it was possible to hold a maximum percentage of the original initial production. Due to these two advantages, the efficiency of extraction was unusually high for a compression plant. A consideration of these points is essential in evaluating the results obtained by the operation of the stabilizers.

Process Described

Although the apparatus was described in Mr. J. A. Rafferty's paper at the convention a year ago, and has since been described elsewhere, I believe that a brief review of the important points would not be amiss. The stabilizer is essentially a rectifying column in connection with a still or kettle operating at relatively low temperatures. It is an adjunct to a natural gasoline plant, not a means of extracting gasoline from natural gas, and is applicable to any type of plant whether it be compression, oil absorption, charcoal, or any combination of these processes. Its function is to handle the condensates currently as made in the various plant cycles and to separate from these condensates all the gaseous constituents and to leave remaining in the finished product all the liquid fractions which may be desired.

The various condensates as produced are continuously expended directly into the column at appropriate points. The highest gravity, most volatile fraction is admitted nearest the top and that most nearly approaching the quality desired in the final product is introduced nearest the bottom of the column. As the liquids are carried under the pressure at which they are produced up to the expansion valve on the column, there is a very appreciable refrigerating effect due to the evaporation of the lighter fractions. This refrigerating effect is, of course, most noticeable at the top of the column where the lightest fractions are admitted.

The column is equipped with trays and means are provided for the downward flow of liquid and the upward flow of vapors. Of the condensates admitted to the column, such portions as remain liquid, pass from the bottom of the column through a "U" trap into the kettle. This latter is usually a horizontal storage tank which has been modified to suit the need by being equipped with a steam coil and a vapor pipe to conduct the vapors evolved in the kettle into the base of the column. Means are provided for maintaining in the kettle a constant temperature at any desired point and for maintaining a constant pressure on the kettle and column. A temperature gradient is thus maintained between the base of the column, which is kept warm by the vapors entering through the kettle, and the top of the column which is kept warm by the vapors entering through the kettle, and the top of the column which is kept cold by the refrigerating effect produced by the expansion of the light liquids. The base of the column is maintained at a sufficiently high temperature by the warm vapors that liquids descending in the column are freed of all gaseous constituents. The top of the column is maintained by the refrigeration at a temperature sufficiently low, that the wild vapors leaving contain no true gasoline constituents, all such having been condensed out by contact with the cold liquid. A part of all of the vapors leaving the top of the column are recompressed and the condensate thus produced is admitted to the top of the column to augment the volume of cold liquid wash.

Efficiency Dependent on Extraction

As the stabilizer is not a means of producing gasoline, it is dependent for its maximum efficiency upon the initial extraction of the gasoline plant at which it is installed. It may, therefore, be necessary to take steps to improve the extraction at some plants if the maximum production from the gas is to be obtained. In a compression plant where the machinery is capable of it, this may be done by increasing the pressure or by improving the cooling conditions. In an absorption plant the increased initial extraction may be obtained by one or a combination of the following changes, to-wit: increasing the gas pressure, increasing the rate of oil circulation, or decreasing the oil temperature. Every individual problem will have to be studied separately. Where a charcoal test of the total residue leaving the plant shows no appreciable gasoline content, it will probably be unnecessary to make any changes in the plant operation when the stabilizer is installed.

While the description of the apparatus makes it appear complicated, the actual operation is simplicity itself. Admission of the liquid to the towers is controlled by motor valves actuated by air or gas pressure from regulating float placed on the accumulator tanks. The pressure on the system is controlled by a suitable check regulator on the outlet pipe from the tower and the temperature on the kettle is controlled by a thermostat. All other conditions remaining unchanged, the quality of the product collected in the kettle may be varied merely by adjusting the temperature regulator on the kettle and allowing the system to establish equilibrium under these conditions.

Saving Greater

For a product of any given distillation recovery, the stabilizer will permit the saving of more gasoline from any plant than is possible by ordinary weathering methods even of the more efficient types. It should be borne in mind in operating the stabilizer that if the kettle temperature is raised to produce a gasoline of lower gravity or higher distillation recovery, a decrease of yield must be expected. Conversely, its conditions permit the production of higher gravity, lower distillation recovery product, the temperature of the kettle may be lowered to attain this result and an increase in yield may be expected. Even though a gasoline is produced of relatively low distillation recovery, that is from 75 to 80 per cent, the product is still stable and will contain no propane or other gaseous constituents. The change in gravity and distillation recovery of the stabilized product by lowering or raising the kettle temperature is entirely due to including a greater or less percentage of butane.

Gravity Higher

A brief inspection of the characteristics of the individual constituents usually found in natural gasoline may be of interest at this point. Methane and ethane have such low boiling points that they are ordinarily present in gasoline only in very minute quantities. Propane boils under atmospheric pressure at a temperature of minus 47° F. Varying with the type of plant and the quality of gas handled, propane is ordinarily included in natural gasoline even when weathered for shipment to an amount of 1 to 4 or 5 per cent. Natural gasoline containing two and one-half or three per cent of propane is not at all unusual. It is not difficult to see why ordinary gasoline boils when it contains two or three per cent of a compound which has a boiling point of minus 47 degrees Fahrenheit. The unfortunate part of it is that although propane will boil when alone at this

*Presented at the Annual Meeting of the Association of Natural Gasoline Manufacturers in Tulsa April 23-24.

low temperature, it can be freed from natural gasoline only by exposure to such high temperatures that very large proportions of the valuable constituents are also carried off. Ordinary weathering process cannot, therefore, free natural gasoline of propane without such abnormal loss as to be commercially impracticable. Butane, the next higher in the series, boils at 32 degrees Fahrenheit and may be combined in a natural gasoline in relatively high percentages without abnormal losses in handling. As pentane, the next higher in the series, boils at 97 degrees Fahrenheit, there is no question as to the desirability of including all of it and the heavier compounds of the series which may be present in the natural gas being treated. By eliminating the propane, amounting to two or three per cent, it is possible to add a very much larger percentage of butane and still maintain the same distillation recovery on the finished product. The gravity of the product will, of course, be higher for any given distillation recovery, when the stabilizer is used, due to the greater percentage of butane included.

Although the distillation recovery is an excellent relative method to determine the volatility of natural gasoline, it must be borne in mind that the losses involved in the distillation test are so far in excess of these involved in the normal handling of natural gasoline as not to be comparable. This is particularly noticeable in stabilized gasoline. As butane boils at 32 degrees, there is a very considerable proportion of the butane content which is not recondensed in the fractional distillation test, the condenser of which is maintained at a temperature of 32 to 34 degrees Fahrenheit.

Due to the complete freedom from dissolved gas, stabilized gasoline even of low distillation recovery may be handled or blended with very low losses. When combined even in high percentages in motor fuel, the stabilized gasoline is retained in the motor fuel much more satisfactorily than ordinary natural gasoline of equal distillation recovery. This is indicated both by distillation tests and weathering tests on the blended fuel.

Flexibility of Control

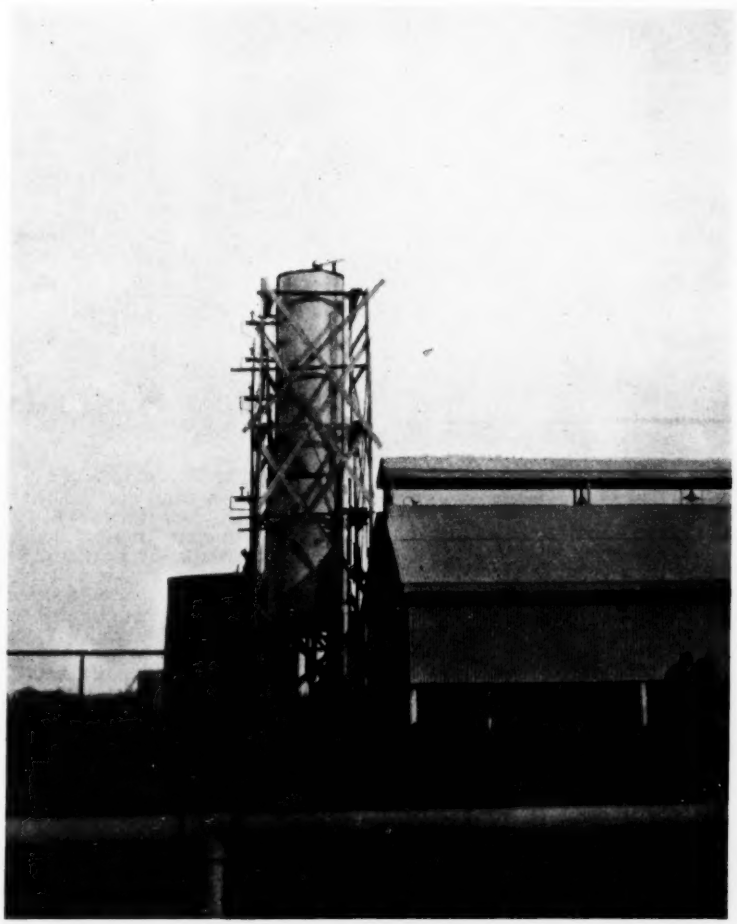
In addition to the simplicity of the apparatus and the ease with which the stabilizer is operated the flexibility of control is worthy of note. As indicated above, the quality of product may be varied merely by adjusting the temperature regulator on the kettle. It should be understood in this connection that at any one time the stabilizer produces one and only one quality of finished product. Thus the temperature control could be adjusted so that the distillation recovery of the finished product would be 85 per cent. While so adjusted only that one product is obtainable from the system, which is somewhat different from the usual gasoline plant operation. Ordinarily two or three products are being made simultaneously in a gasoline plant and these may be combined if so desired in various proportions to make products of varying specification. With a stabilizer, operation must be continued under one set of conditions until the requisite amount of gasoline of corresponding specifications has been produced, after which the temperature may be varied to produce gasoline of different specifications. Thus, where a plant is called upon for gasoline of several specifications, it will be necessary to carry some stock on hand if immediate shipments are desired. On the other hand, the stabilizer makes finished gasoline continuously and no tankage is required for weathering or storing unfinished product. The steam consumption is abnormally low. The condensed water from the heating coils at one of the stabilizers was measured which indicated a steam consumption of seven boiler horsepower for a plant having a net production of 12,000 gallons per day.

Has Ready Sale

To the gasoline manufacturer the direct advantage of the stabilizer is, of course, the increase in production which may be obtained as compared to ordinary operation when producing gasoline of the same distillation recovery. There is another important advantage less easily measured, but none the less appreciable, in the sales value of the product. The stabilized gasoline will undoubtedly demand a ready sale as soon as it has been generally tried out by refiners. The value to the refiner will be reflected either in somewhat higher prices paid to the gasoline manufacturer, or in times of distress will allow the gasoline manufacturer making stabilized gasoline to move his product when it is difficult to find a market for ordinary raw. There are other advantages, but these are rather attendant upon the two main ones just outlined and will be discussed in connection with them.

Loading Losses Reduced

Possibly as striking an indication of the increased production obtainable with the stabilizer is the increased gravity for any given distillation recovery. Where shipments of natural gasoline from Burkburnett over a period before the application of the stabilizer averaged 88.0 gravity for a distillation recovery of 82.2 per cent, the present shipments are averaging 90.7 degrees A. P. I. with a distillation recovery of 82.8 per cent. Thus for a gasoline with a recovery 0.6 per cent higher, the gravity is 2.7 degrees higher. Our experience has generally indicated that for the same distillation recovery, the gasoline will have a gravity approximately 3 degrees higher. As the stabilizer does not remove any of the heavier fractions, but does remove gaseous constituents, substituting butane therefor, increased production is reflected by the increased gravity of the product. Strange as it may seem, this increased gravity is accompanied by very much decreased handling losses. For the present month on shipments of stabilized gasoline of



View of Stabilizer under construction at the Tidal Refining Company's Burkburnett Plant No .1

82.8 per cent distillation recovery, which is slightly lower than our average shipments of last year, the loading loss was one-sixth of our average for 1923. From the high loading loss on ordinary natural gasoline, it is possible to remake and save approximately one-half the gallonage by the use of loading dome covers. With the present shipments of stabilized gasoline it is possible to remake practically the entire volume so that the net loading loss is nearly negligible. In a similar manner the loading loss on blends has been reduced to approximately one-fifth of the previous loss.

For the year 1923, the net volume of gasoline loaded in tank cars from our Burkburnett plants averaged 74.02 per cent of the initial production before weathering or loading. At the present time, this figure is running from 93 to 96 per cent. To make the figures clear, let us assume a given volume of casinghead gas, from which, according to the operation for several months just prior to the installation of the stabilizers, we were able to produce initially, before weathering or loading, 100 gallons of gasoline, and from which we were able to ship in tank cars, 74 gallons net Under the present stabilizer operation our initial production is slightly decreased, so that we are now making originally at the plant 93 gallons as compared to the 100 gallons initially made on the old basis. As noted above we are now able to ship 93 to 96 per cent of the initial stabilizer production. Taking 93 per cent of 93 gallons, we find that the present shipments are 86.5 gallons in tank cars as compared to 74 on the old basis. Thus from the same volume of gas where we were shipping 74 gallons, we are now shipping 86.5, an increase of 17 per cent. This increase is obtained in spite of the fact that the quality of the raw now utilized in blending is much better than that previously used. Where no blending is done or where it is possible to duplicate conditions exactly before and after the introduction of the stabilizer, I believe that increases of 20 to 30 per cent will not be unusual even on efficiently operated plants. The figures above apply at our No. 1 plant where conditions more nearly duplicate those existing prior to the installation of the stabilizer. It is unfortunate for the purpose of this paper that our two Burkburnett plants are operated to a considerable extent as one unit, the production from the No. 2 plant being transferred daily to No. 1 for shipping or storage. Stabilizers are now being constructed which will be installed as soon as ready, at individual plants where these complications do not exist. Three of the new installations will be on absorption plants, two of which are supplied with blending material, the remaining one making raw exclusively. Particularly from the latter should we be able to obtain data which is more readily comparable, as to the exact increase in production due to the stabilizer alone.

Refiner Profits

The advantages of stabilized gasoline to the refiner are numerous. As pointed out above, such advantages to the refiner are also of benefit to the natural gasoline manufacturer, whether he is a refiner or blender or merely a producer of raw for sale to refiners. In the cases where the gasoline manufacturer is also a refiner or blender, the advantages that accrue in blending with stabilized gasoline react directly to the benefit of the gasoline manufacturer. Where the stabilized gasoline is sold as raw to a refiner, the refiner's advantage will be reflected in part at least to the natural gasoline manufacturer through increased price or in improved marketing conditions.

The advantage which is first noticed is the reduced loss in handling and blending stabilized gasoline and the decreased loss in handling and storing the finished motor gasoline in which stabilized gasoline has been used. As almost all refiners unload natural gasoline directly into the stock which is to be blended, the same procedure will, of course, be used with stabilized gasoline. In unloading it in this manner, it is possible to receive in the storage tank containing the blending stock the same gallonage which is pumped out of the car within the reasonable limits of accuracy obtainable in ordinary gauging. The loss in storing the finished product blended with stabilized gasoline is no greater than the loss in storing gasoline of equivalent specifications made direct from the crude. It is not my intention in any way to discredit the use of natural gasoline in refinery operation as it is so very generally and so uniformly satisfactorily used by the great majority of refiners. I do wish to point out, however, that stabilized gasoline with its absolute freedom from dissolved gas will give much better results than ordinary natural gasoline. The dissolved gas in ordinary gasoline is still present in the finished motor fuel containing it. This gas is continuously making an effort to free itself from the gasoline in which it is in solution and in leaving the gasoline carries on in the form of a saturated vapor true liquid constituents of the gasoline. The loss is, therefore, not confined to the volume of gas which escapes but is augmented by the volume of heavy vapors which the gas carries with it. In stabilized gasoline no dissolved gas is present and, therefore none can exist in the finished gasolines made therefrom. Losses are therefore minimized, being due only to the evaporation of true liquid constituents.

Results Shown by Tests

The freedom from gas and the stability of the lighter fractions of stabilized gasoline can probably be most conclusively shown by a series of tests, of which several examples will be given. A sample of stabilized gasoline is heated over a water bath or similar device to drive off the lighter fractions which are absorbed in blending material. In all such tests we have found that the total of the net volume of gasoline remaining in the flask and the net increases in the blending material is 99 per cent or more of the original volume of the stabilized gasoline. In most cases approximately 50 per cent or more has been evaporated and yet this amount has been recondensed and the total loss in the operation has been less than 1 per cent and in many cases is not measurable. Thus a stabilized gasoline of 90.6 gravity and 80 per cent recovery was heated to drive off 56.5 per cent which was recondensed in 54.1 gravity naphtha. The volume of naphtha was such that the light portions of the stabilized gasoline blending with it made a finished gasoline containing 14.3 per cent of the light fractions of the stabilized raw and 85.7 per cent of the naphtha. The finished gasoline had a gravity of 59.3 and a recovery of 96.0 per cent, meeting navy specifications throughout with the exception of being a little high at the 50 per cent point. A more careful selection of the original naphtha would have permitted meeting this point as well. It is important to note that not only is there a loss of but 0.7 per cent in this test, but that the finished gasoline so produced has a very satisfactory distillation recovery, even though it contains only the light fractions of the stabilized gasoline, which would not be the practice commercially. The distillation tests on the various products are shown below:

	Stabilized Gasoline	Naptha[1]	Blend[2]	Stabilized Residue[3]
Gravity	90.6	54.1	59.3	77.5
IBP	60	168	112	95
10	70	222	154	113
20	79	248	208	120
30	89	265	247	128
40	99	282	252	136
50	114	300	292	145
60	136	318	312	156
70	166	335	330	160
80	206	355	352	186
90	...	381	386	213
E. P.	240	440	434	288
Rec.	80.0%	98.5%	96.0%	98.0%

[1]Used as blending stock.
[2]Contains 85.7% of naphtha and 14.4% of the light fraction of the stabilized gasoline amounting to 56.5% of the original stabilized gasoline.
[3]Amounts to 42.8% of the original stabilized gasoline remaining after heating.

In another test a blending stock was used which was less deficient in light ends than the one noted above, so that the finished gasoline produced was far superior to navy specifications at every point. In this case also the loss was less than one percent (0.8% to be exact). For comparison, another column is included showing a blend containing the same amount of naphtha but using the entire stabilized gasoline in place of only the light fractions. As might be expected, this blend containing as it does all of the stabilized gasoline, has a somewhat higher initial boiling point and a distillation recovery 1% better. However, the one containing the light fraction alone is a very satisfactory gasoline and is in no way too volatile for ordinary use. The tests are as follows:

	Stabilized Gasoline	Naphtha[1]	Blend[2]	Stabilized Residue[3]	Blend[4]
Grav.	93.2	54.8	60.4	82.2	59.3
IBP	63	118	88	86	99
10	66	194	128	96	143
20	73	215	179	104	183
30	81	235	220	112	215
40	91	256	245	120	242
50	101	273	268	130	264
60	116	290	289	140	286
70	138	313	315	151	310
80	185	336	345	169	338
90	...	370	388	192	376
E. P.	266	435	435	289	437
Rec.	85.5	98.0	96.0	98.5	97.0

[1]Used as blending stock.
[2]Contains 84.6% of naphtha and 15.4% of the light fraction of the stabilized gasoline amounting to 51.5% of the original stabilized gasoline.
[3]Amounts to 47.7% of the original product remaining after heating.
[4]Contains 85% of naphtha and 15% of original stabilized product before heating.

At the risk of repetition I wish to point out that this is not intended as a

(Continued to page 20.)

Methods Used By California Operators

Manufacturing natural gasoline on West Coast unlike that in Mid-Continent

By Carl J. von Bibra

IN California at least, natural gasoline seems to be a very good index of the refined oil market. It is volatile both in composition and in price. Whenever the motor gasoline market has been strong in recent years California natural gasoline has sold at prices above the retail service station price of the straight-run product. On the other hand, in a weak motor gasoline market natural gasoline has sunk to price levels far below the refinery cost of manufacturing straight-run gasoline. There are several reasons for this. In the first place, there has been a general prejudice against storing natural gasoline. The impression has persistently prevailed that storage losses would be prohibitive, despite the fact that it has been demonstrated several times that the product could be stored without marked depreciation in quality at a cost not exceeding 3½ cents a gallon for the first year and less than half for the succeeding years. These figures take into consideration writing off tankage and other storage equipment in one year, insurance on both product and equipment, evaporation loss and interest.

Mostly Small Concerns

The reluctance of natural gasoline manufacturers on the Pacific Coast to store the product during periods of depression is also largely due to the fact that most of them are small concerns, often inadequately financed and therefore unable to carry a large inventory for a long period. During the last period of depression a serious attempt was made to work out a community storage scheme, but this also failed.

A third factor entering into the wide fluctuations in price of natural gasoline on the Pacific Coast is that most of the product which gets into the open market is bought by small refiners supplying a local service station trade only. These small refiners all manufacture a certain amount of straight-run gasoline. The amount they manufacture is generally insufficient to supply all the trade that they can handle during periods of greater than usual demand; therefore in such periods they become buyers of natural gasoline on a very extensive scale. Since they all follow more or less the same policy, they bid the price up against one another. As natural gasoline enables them to enhance the value of a considerable proportion of heavy naphtha and sell the mixture in competition with or blended with their straight-run gasoline, they are able to pay a price for natural gasoline as high as or higher than the retail service station price of refinery gasoline. This accounts for some of the high prices which we have seen in the past for the natural product.

The other side of the picture is that during times of depression in the gasoline market the small refiners can supply their entire trade out of the straight-run which they manufacture and consequently they do not require any natural gasoline. The many small manufacturers therefore find themselves practically without a market. Hence the extremely low prices reached during such times.

Much Never Sees Market

There is much natural gasoline manufactured on the Coast which is never put on the open market. Several of the largest oil companies in California are definitely committed to the policy of not blending natural gasoline with their straight-run product. These companies are large producers of natural gasoline and pump the entire product of their plants directly into their crude oil lines. Several other large companies which are producers, refiners and marketers of petroleum products are also manufacturers and buyers of natural gasoline. Consequently all their own natural gasoline production is used in their own refining and marketing operations and therefore is never sold in competition with other natural gasoline manufactured by small concerns who are exclusively in the natural gasoline business.

The accompanying article is the third of a series on refining practice on the West Coast and deals with the natural gasoline division of this department. While the natural gasoline industry has become a big factor in refining in California it has not yet reached the successful stage of operation maintained by manufacturers in other parts of the country. —The Editor.

The result of all this is that probably less than half of the twenty odd million gallons per month of natural gasoline now being manufactured in California is sold on a competitive basis. That portion which is sold competitively has shown a price fluctuation of more than 20 cents per gallon over relatively short periods of time. Natural gasoline prices have at times fluctuated 2 or 3 cents before any price adjustments took place in other California refined oils. This fluctuation in natural gasoline has, however, been a consistent index of the firmness or softness of the California refined market.

Sidelights on Production Costs

Under all ordinary circumstances natural gasoline can be manufactured more cheaply than the straight-run refinery product. The exact cost of natural gasoline to the manufacturer of course varies with his policy. Some of the California gasoline manufacturers operate on a basis of very efficient, and therefore expensive, plant equipment. While the yield of gasoline for the quantity of gas handled is high, the fixed charges on the plant are correspondingly high. In any stable industry it is evident that efficient equipment is a paying proposition. In the natural gasoline industry this is not always the case. This is due to several things. In the first place, the gas supply is very often extremely uncertain. A plant may be built to handle a certain quantity of gas and at the time it is ready to start operations actually find gas available for several hundred percent of its capacity, and then a very few months later have barely enough gas to meet operating costs. Secondly, an efficient plant is necessarily less mobile than one designed to merely strip a reasonable proportion of the gasoline out of the gas. The greater the efficiency of the plant, the greater the amount of cumbersome heat exchange apparatus, cooling tower piping, etc., involved. The experience of most natural gasoline manufacturers has been that it is decidedly good policy to so construct their plants that they can be readily moved from field to field as old sources of gas supply give out and new ones become available. This necessary mobility of plant equipment militates against the construction of complicated apparatus.

Gathering Costs an Item

Another factor limiting the justifiable expense for plant construction is the high cost of extensive gas gathering systems. The larger, more efficient and therefore more permanent the plant, the more elaborate the gas gathering system required to protect the investment by furnishing gas for the plant to run on. It is very easy to spend as much on a gas gathering system as has been invested in the plant which the latter serves. Particularly in new fields, it is very difficult to estimate in advance the length of time for which gas will be available from any given lease or group of properties. A large flush production of gas may come in and lines are laid to take care of this, and in a short time the gas will have dwindled to a very small fraction of its original volume. This is the same trouble which was previously discussed in connection with the construction of the plant. The essential difference is that a good gasoline plant has a very high salvage value, whereas a pipe line system has a very low one, varying probably from about 20 to 50 per cent of the cost of construction. Hence it can readily be seen that there is much greater danger to the natural gasoline manufacturer when he has a large proportion of his capital tied up in a gathering system than when he has it invested in a number of readily movable plants each with a very simple gathering system. This explains the tendency which has been growing in California during the last few years to have several plants of

moderate efficiency making gasoline for one company in the same field.

Dry Gas

While the natural gasoline industry is not directly concerned with the production and marketing of fuel gas, the two fields of endeavor are, nevertheless, so closely related that one cannot be discussed without taking the other into consideration.

The natural gasoline industry in California is at the present time established on the basis of a royalty of from 20 to 40 per cent of the gasoline extracted being paid to the producer of the gas, either in kind or cash. There are isolated instances in which royalties of less than 20 per cent and more than 40 per cent are being paid. A fair average royalty in California at the present time is 33⅓ per cent of the gasoline extracted if the gasoline manufacturer obtains title to the residual dry gas and is not obligated to return any of it to the producer. If the manufacturer has to return dry gas for fuel purposes to the producer, or is obligated to turn over to the producer all or a considerable portion of the receipts from the sale of dry gas to a gas company, the gasoline royalty is proportionately lower. If the producer receives anything for his dry gas or has gas fuel delivered back to his lease, it is customary to pay a royalty of about 25 per cent of the gasoline extracted.

There is a fair but fluctuating market in California for the residual dry gas from well established gasoline plants. During periods of flush production most of the residual dry gas from the plants is blown into the air. This is one extreme. On the other hand we find that in settled producing areas there is very little gas blowing to waste, practically all of it being taken regularly by the large gas companies. The price obtained for residual dry gas in the field varies from 4 to 10 cents a thousand cubic feet, depending on the pressure at which the product is available, its location in relation to the lines of the purchasing company, regularity of supply, etc.

Apparatus

The Standard Oil Company (California), Union Oil Company of California, Shell Company of California, General Petroleum Corporation and Pacific Gasoline Company are California's largest natural gasoline manufacturers. Each of these companies builds its plants on original designs developed by itself. Some of the other gasoline manufacturers also have characteristic designs of their own, but most of them have plants designed by the Southwestern Engineering Corporation, Carl F. Braun or Dan Newton. Several of the gasoline manufacturers above mentioned also use Braun or Southwestern heat exchange apparatus in conjunction with their own plant design. The Southwestern and Braun equipment lends itself readily for use in plants of any desired unit capacity. The Newton plant differs from the others in being designed primarily for small units. It is the so-called "Jitney" gasoline plant which received much favorable attention during and since the recent boom.

The absorption process is the most highly favored in California. There are a number of compression plants in operation, but so far as the writer knows, no new ones are being constructed; whereas some of the plants which were originally compression have been converted into absorption plants, the compressors being used as boosters to bring the gas into the plant. In the last two years a large number of absorption plants were built in the Los Angeles Basin fields. With few exceptions, these plants were operated at well pressure. At the present moment they are just about at the point where most of them have had to arrange for booster plants. For this purpose 160 horsepower compressor units are generally favored, although in some of the small plants 80's, 50's and 40's are also being used. Various standard types of gas engines are being used to drive the compressors and combination engine-compressor units are also in good favor.

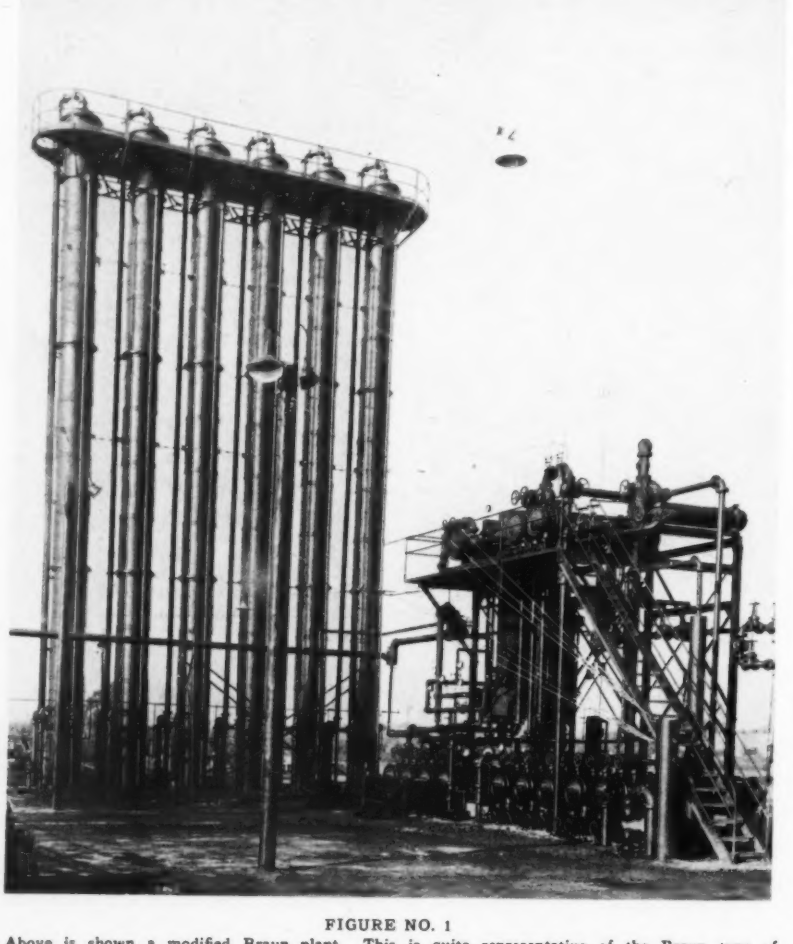


FIGURE NO. 1

Above is shown a modified Braun plant. This is quite representative of the Braun type of absorption apparatus widely used in the California natural gasoline industry.

Number of Plants

There are about thirty-five gasoline plants operating at the present time in San Joaquin Valley fields. Thirty-three of these are in the Midway-Sunset fields. They are producing at the rate of about 130,000 gallons per day. There are four plants in the Santa Maria field whose production is reported to be about 20,000 gallons a day. In Southern California a production of 15,506,053 gallons was obtained during the month of March. This is a daily average of 500,000 gallons. The Associated Oil Company, in collaboration with the various gasoline manufacturers, makes a monthly estimate of this Southern California production, and writer is indebted to the Associated for the above figures as well as the following table:

March (31 days)

Field—	Gas M. Cu. Ft.	Gasoline Gals.
Coyote	64,681	51,154
Dominguez	25,000	18,920
Fullerton	476,022	655,877
Huntington Beach	1,557,343	2,161,007
Long Beach	8,301,265	5,530,598
Montebello - Whittier	105,061	38,321
Newhall	9,010	24,326
Richfield	352,050	560,547
Salt Lake	112,700	84,566
Santa Fe Springs	4,118,365	5,813,200
Torrance	385,358	262,571
Ventura	315,395	304,966
Total March	15,822,250	15,506,053
February (29 days)	17,476,299	14,634,537
Increase in gasoline production (gals.)		871,516

The San Joaquin Valley natural gas-

oline production is more or less settled. Unless new and extensive producing areas are developed, which is of course always a possibility, no radical change in the natural gasoline situation in this area can be expected in the immediate future. In Southern California the big natural gasoline production has been developed the last year at Santa Fe Springs, Long Beach and Huntington Beach. These three fields during the month of March produced 13,000,000 out of the 15,000,000 gallons produced in all of Southern California. Santa Fe Springs and Huntington Beach have both passed their peak, but Long Beach is producing more natural gasoline now than ever before. The gas in this field has been the leanest of the three but is now becoming richer all the time as the well pressures decrease.

At this point it may be interesting to note that natural gas being treated in California varies in richness from about four-tenths of a gallon per thousand cubic feet to more than 3½ gallons per thousand cubic feet. The average yield for the state is a trifle better than one gallon per thousand.

The new fields which are engaging the attention of gasoline manufacturers at the present time are Torrance and Dominguez, and if present expectations are fulfilled, the prospective field of Rosecrans (Athens on the Hill). All these districts are just a few miles south of the city of Los Angeles.

Characteristics of California Natural Gasoline

Most of the absorption gasoline manufactured from the rich gas produced together with the high gravity Los Angeles Basin crudes varies in gravity from 73 to 82 degrees A. P. I. The amount recoverable in a Bureau of Mines distillation varies from 75 to 90 per cent. The end point varies from 330 degrees F. to 430 degrees. Good colors are obtained, practically all the high gravity natural gasoline on the market being offered on the basis of a 25 plus Saybolt color. Below is given a typical distillation of a Santa Fe Springs absorption gasoline:

A. P. I. Gravity	80.2°
Initial Boiling Point	70° F.
5%	77
10%	89
20%	98
30%	114
40%	132
50%	150
60%	171
70%	200
80%	235
Dry Point	393
Loss	14%

Absorption gasolines manufactured in Torrance and similar fields are ranging somewhat lower in gravity than the one described above. A typical Torrance absorption gasoline has an A. P. I. gravity from 68 to 71 degrees, an initial of 90 degrees F. and an end point of 340 degrees F. Low end point absorption gasolines are the rule in California at present, 330 degrees end point not being uncommon and 375 degrees being a general average. Because of the very slight amount of absorber oil entrained in the gasoline, the end point really indicates nothing in particular, and it is unfortunate indeed that the natural gasoline industry should have its product evaluated on the same basis with straight-run gasoline. Obviously the end point as determined is a very unfair criterion of the value of the absorption gasoline.

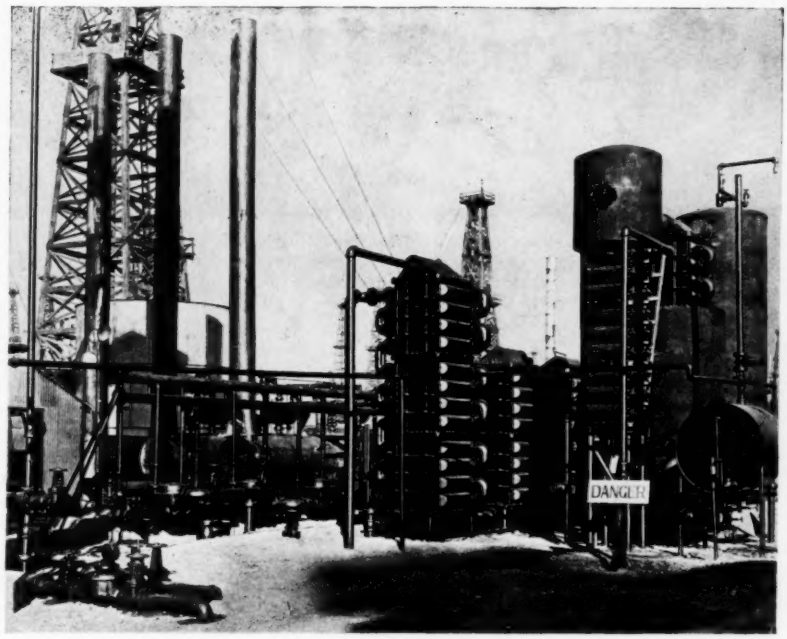


FIGURE NO. 2

This illustration serves to give a good idea of the characteristic Southwestern absorption plant equipment. A number of the most recently built gasoline plants in California are of this construction. The absorption towers (not shown here) are very similar to those shown in Fig. No. 1

Off-Color Gasoline

It is a rare absorption plant which does not occasionally get a batch of off-color gasoline. Last year, during the period of flush production in California, much distressed gasoline was sold by the manufacturers. When a tank full of off-color material was obtained it was sold at next to nothing in order to get it out of the system. If the manufacturer had surplus still capacity he re-ran the off-color tank and took his evaporation loss as a matter of course. During the last few months, however, there has been a noticeably increasing tendency in the natural gasoline trade to use adsorptive clays for the reconditioning of off-color gasoline. No special apparatus is required. The powdered clay can be dumped directly into the tank and agitated either with air or by pump. After the treatment is completed, the clay settles out rapidly and need not be removed until the tank is emptied. The cost of treatment varies from 6/10c to 8/10c per gallon. Practically the entire cost is due to evaporation, as only a nominal amount of clay is required.

Present Tendencies

From the physical viewpoint, there is a marked inclination at the present time to raise the end point of absorption gasoline made in California. This of course carries with it an increase in the percentage recoverable on distillation and lowers the gravity to a slight extent.

In plant equipment the tendency is strongly in favor of absorption plants built on the multiple unit plan, so that the capacity of any one plant can be varied by the addition or removal of one or more units complete within themselves. Standardized heat exchange apparatus and absorption towers manufactured by reputable specialists in this type of engineering construction are gaining favor every day.

In the marketing end of the business no particular change is noticeable. As pointed out in this paper, only about half of the gasoline produced in California is sold competitively on the open market. However, the gasoline which is marketed in this way is subject to extremely severe competition in times of stress. There seems to be no particular disposition on the part of the small manufacturers to consolidate into larger concerns or to form a trade association. The California natural gasoline industry has all the earmarks of still being in the formative stage of its development, and the future will probably see two or three strong companies rise to the top. These will naturally dominate the market to a large extent.

New Plants Operating

The new gasoline plant of the Empire Gasoline Company in the Thrall pool in Greenwood County, Kansas, now is in operation. It is being operated as a branch to its main plant at Teeter in the same district. This has been the means of increasing the output of the Teeter plant from 1800 gallons daily to 2000 gallons.

Problems We Have Met in Plant O

As told at the round table dis Association of Natu

AT THE session given over to plant operators and superintendents at the annual meeting of the Association of Natural Gasoline Manufacturers many interesting efficiency hints were made. The following report covers the more important discussions:

Water Problems

Chairman Ballard: "All right, what about water troubles? Can't somebody give us their experience about water? Has someone any suggestions to make about this? Have any of you any suggestions on condensation?"

Mr. Schaefer, H. F. Wilcox Oil and Gas Company, Tulsa: "Mr. Boyd of Salt Creek has a proposition. He has two water supplies; one of them comes from Little Salt Creek. This salt water, he runs through his cylinders; and in the course of time causing a scaling up, it scales up his principal line. Then he has another line, which is a surface water pond, mostly silt, he turns that through it, removing the salt and leaving a clean cylinder. Then switching back to salt, the salt cuts the silt and the silt cuts the salt. That is the way he is working it. The result is after he has operated the plant about four years now the cylinders are clean.

Mr. Boyd of Salt Creek: "Mr. Chairman, I don't think Mr. Schaefer went quite far enough because he didn't tell when I made the changes from one water to another, going from the salt water back to the pond water, the salt water ate up an eight-inch line in 30 days. I want somebody to tell me how to overcome the trouble with the exhaust line."

Chairman Ballard: "That is the exhaust line from the engine?"

Mr. Boyd: "The exhaust pipe from the engine after I made this change and I cleaned out the jacket, the water will eat up an eight-inch line in 30 days."

Chairman Ballard: "Anybody have a suggestion on that?"

Suggests Method

Larry Olansen, Chestnut and Smith Corporation, Kiefer, Oklahoma: "When you change from silt to salt, there is a galvanic action takes place. You can overcome that when you overcome your static or electrode."

Chairman Ballard: "That is a good suggestion. You boys who are having trouble with your exhaust lines Mr, Olansen has made the suggestion how to remedy that. Another one might be to put in cast iron pipe."

Mr. Olansen: "It will be the same in any boilers. Where you have four or five or ten or fifteen boilers running, running a fair temperature, it will take a galvanic action to bring about the cylinder scaling; in time your scaling will disappear but your boiler will leak."

Mr. Peters: "May I ask what temperature is maintained on the overflow?"

Mr. Boyd: "About 104."

Chairman Ballard: "Any more suggestions or questions on the water proposition?"

Knock-Out Box Trouble

R. L. Huntington, Skelly Oil Company, Slick, Oklahoma: "The other day I had trouble with the knock-out box, had a three-inch stream going in there through it, wasn't a sufficient fluid. I had to pump a barrel of this Dearborn solution in the knock-out, it clogged up, the water boiled over, and the problem was how long it had been in the knock-out—if there is any danger of getting through it and vapor escaping. However, one way, I drained the solution out and got very good results."

Chairman Ballard: "Have any of you any suggestions to offer on that treatment of Mr. Huntington's?"

Mr. Young: "We put through about five pounds."

Chairman Ballard: "Now, have any of you anything more on the water? We must have trouble, boys, because George Massey spends a lot of time down in this country."

Treating With Minerals

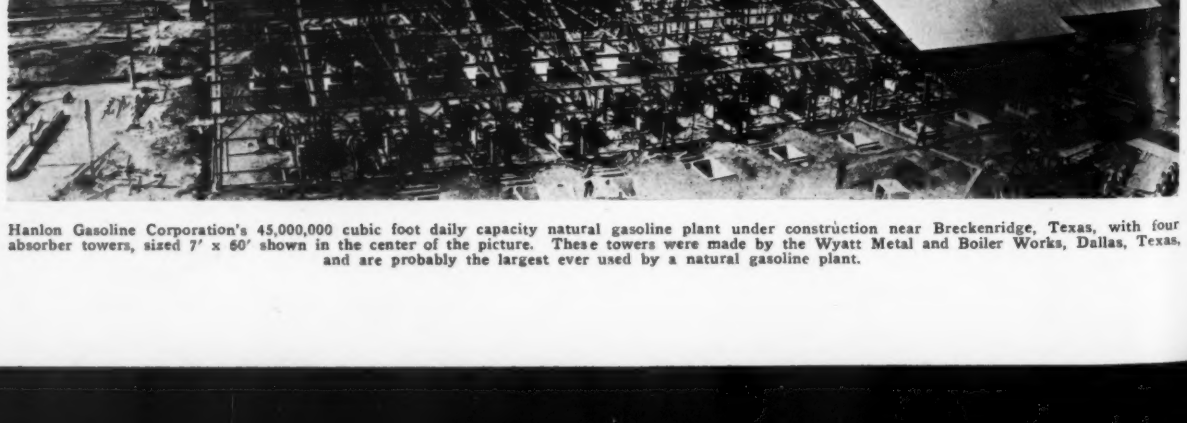
Mr. C. A. Holmes, Wilcox Oil and Gas Company, Slick, Oklahoma: "Mr. Chairman, I have a question to ask. If you are going to use water in your knock-out valves, why can't it be treated with mineral salt oil and get away from those water troubles?"

Chairman Ballard: "The gentleman wants to know, if you use water in the knock-out box, why not use mineral salt oil to get away from the water trouble."

"Mr. Young says he doesn't feel that he should take his mineral salt oil and heat it; he has trouble enough getting it cool, so he doesn't feel like using the cool mineral salt oil as a cooling medium in his knock-out box as water will save him a lot of work by recooling this mineral salt oil."

Method Is Used

Mr. Schlosser: "Mr. Chairman, the gentleman has made a good suggestion and one that has worked out successfully in a number of different places. There are a number of ways in which you can use mineral salt oil for cooling. The only effect that you



Hanlon Gasoline Corporation's 45,000,000 cubic foot daily capacity natural gasoline plant under construction near Breckenridge, Texas, with four absorber towers, sized 7′ x 60′ shown in the center of the picture. These towers were made by the Wyatt Metal and Boiler Works, Dallas, Texas, and are probably the largest ever used by a natural gasoline plant.

...n---and How They Were Overcome

...at the annual meeting of the ...line Manufacturers

want to produce in your knock-out box is to take your oil as fluid as it is sometimes, and by taking that from the absorber and running that through a knockout-tower in place of water you get the effect you want, without the formation of scale. You can run that in a duplicate affair or you can run it through a tower and let it drip down over some sort of vacuum device and let it in that way come in direct contact with your vapor that comes from your power and in that way you won't have the effect that you will have with water."

Chairman Ballard: "Any other question on this water proposition?"

Robs Heat Exchange

Mr. Foster: "We have tried mineral salt oil as a knock-out medium, for cooling that knock-out, and we find that it is very satisfactory as a cooling medium, but it robs the heat exchange between the hot and cold oil to the extent of oil that is being used in the knock-out for cooling purposes. During cold weather in this country that can be easily sacrificed, during warm weather, however, it would be necessary to put up another system."

Many Small Troubles

Mr. Schlosser: "It is rather strange to me, Mr. Chairman, that we do not find any trouble in this room when they have so many in the field. Send a man over some lines to make a report of conditions, and it will be something like this: Fifty or sixty leakng casingheads, leaky gauge nipples, leaky casing, leaky stocks, water in the lines. I know of one case where one particular man has a duplicate scrubber tank coming from the field about 42 inches in diameter, about four feet, something like that and about ten feet high and the report comes to me that the tanks were filled with water.

"It seems to me we ought to hear from some of those fellows, hear of some of the mysteries that are encountered, things that must be fixed in order to hold the production, and there are a great many other little things that don't come into us. Another thing that would be very interesting is some kind of automatic crib to take care of the condensates of the vacuum line. Of course lots of people are not operating under vacuum, some others are. The vacuum systems are about the most difficult to get the water out of.

The broken two-inch plugs that you mentioned. It is customary to use a pipe wrench after the points are off the plugs they are practically useless. Bull plugs are very good."

Handling Vacuum

Chairman Ballard: "On this vacuum question, as Mr. Schlosser has outlined, I am going to call upon one to answer the troubles that appear with air. He had over 70 miles of gathering lines, and when I was connected with him he always thought he had an excessive amount of air. He might give us a lot of information pertaining to that air and water trouble.

"Mr. Yonkers, I believe, can explain that for us. Fred, you had a lot of trouble with air up there in Kansas."

Mr. F. G. Yonkers, Chestnut and Smith Corporation, Ranger, Texas: "Mr. Chairman, I will agree with you, a long story could be written on air troubles. I think a lot of trouble could be eliminated by being more careful when the lines are loaded. I think a great deal of air trouble comes from not allowing for expansion and contraction.

"I am sure that nearly all of the field boys will agree with me that about 85 per cent of the air troubles come from broken fittings, broken threads caused by insufficient allowance for expansion and contraction, and another great trouble is it interferes with the supply of gas to the plant, and the plant is insufficiently drained; that is, I mean by that not a sufficient number of drips. Another great trouble is that a lot of operators in the field put on supplies—they use second hand valves and junk that is passed off, you see, they use that, they think it is good enough for gasoline operators but it works a hardship on the gasoline operators, and I think we could do a great deal of good by calling these different matters to the attention of the oil operators. They use good new equipment and we ought to have equipment as good as they use in the producing end of it, and I think we are entitled to it. We pay for gas, we don't want to pay for air.

"As I have said before, a man might take the stand all day and talk about these air troubles. I am rather disappointed that the boys didn't get up and respond when you gave them a chance to talk about these air troubles, because the first answer you get in the field when you ask about production, they tell you it is air. I suggest, Mr Ballard, if they won't talk, you call them by name and make them talk. If you don't know all these boys, I am sure their bosses will give you their names, and I suggest that all of them be asked to talk."

Uses Stethoscope

Mr. Fisher: "In that line, I had a little experience sometime ago with a man, an employee of the Gypsy Company, in finding air leaks and condensed water in the line, and it happened one evening—I believe a lot of us have been having more or less air trouble, that is during the cold weather and this man instead of taking his shovel and his pick and other digging implements to find his connection, going over his lines, he would walk over the line and apparently would stop and listen for them, and my curiosity was aroused and I found that he was using a form of stethoscope. It is on the market by several different companies, I believe, and is used for detecting knocks in meters. In particular, is that instrument successful where the line is buried beneath the ground; you can place the stethoscope to the line and the air leak is very audible. When a wrench is put on the line, it is something like hitting it with a sledge hammer. In fact, by listening, if you couldn't hear the air leak, it could be heard very distinctly with a stethoscope. Water condensing in the line, in any place in the line, can be heard very distinctly. In fact, by reason of this instrument, this man traced down this air and water trouble and saved him an awful lot of work.

"Now the impression that I got, an instrument of that kind might be difficult to use under some circumstances, but it will save him a great deal of trouble, and eliminate lots of time in finding the source of the trouble. You can use this instrument on buried lines, that is, lines that are buried the greater part of their length; by using the system of driving the rod down through the line and using the stethoscope, the same effect would be obtained.

"I cannot say how much territory this man covers, but he manages to keep his upkeep very low."

Mr. Peters: "Mr Chairman, in tracing up the air trouble on the line, there is a lot of attention paid to the compressor troubles on the line, due the expansion and contraction of the pipe, men are neglectful, and furthermore, we trace the air trouble in many cases directly to the vacuum pump."

Chairman Ballard: "We have one in the house, I am sure can give us some more information pertaining to this air. I understand he has approximately 3500 wells under his jurisdiction, that is, in his dictrict from which he is gathering gas, and I think if Mr. Smith of the Tidal, in charge of the Nowata properties would come forward and talk to the audience, I think what he has found would be helpful. Just come up here, Mr. Smith, and talk back to them."

Has Aid Department

Mr. Smith: "Mr. Chairman, we have lots of air up at our place, all kinds. We have about, roughly speaking, between five and eight hundred miles of vacuum residue lines. The majority of this pipe is composed of three inch 40-D pipe, which is very rotten. A lot of that casing had been in the junk pile, as a matter of fact, before that. I think we have every air trouble up there that is possible for a man to have.

"During normal operations at our

plant, we get 30 to 32 per cent air, say, on our low storage gathering, if we are running in good condition. You know what that means on a compression plant or absorption plant; it hurts us on our volume. We cannot handle the increased volume.

"We have our trouble with leaky casingheads, and I think every possible air trouble that anybody can have, we have it. We have to have an organization to find this air, they do nothing else. We have a welder with a helper and a Ford truck and the air men take the air test on the incoming lines at the plant to determine which lines are the highest in air content. Our line walker, or our air man goes out to find the leaks and reports them by telephone, or by word of mouth, whatever is most convenient and the welder goes out and makes the repairs. We try to keep our drips in good condition, and we don't have as much trouble with the drips on the high as we have on the low vacuum.

"While 55 miles of our pipe is on top of the ground, many, many more miles of it is buried.

"As to the method of fighting this air, I don't know of anything except continuous work and using common sense to locate the troubles and repair it.

"I don't know how you can eliminate all the troubles. All of you know what they are. I would be very pleased to hear from anybody with any special method you have for dealing with the air."

Mr. Osborn: "I might relate the conditions we find in the El Dorado field. We find that on old abandoned wells the increased volume is 50 per cent. We find that we get air through leaky casingheads. We find as high as six and sometimes ten pounds of vacuum on off-set wells. We have considerable air trouble."

Does Air Affect Yield?

Mr. Peters: "Mr. Chairman, I would like to ask, does air affect the yield of the gas?"

Chairman Ballard: "Can anybody answer that question of Mr. Peters; he wants to know what effect air has on production?"

Mr. Warren: "Speaking of air, there are lots of these fellows don't even know what trouble is. In our district, and more especially on one plant built by the O. P. R. in 1916, our construction engineer at that time used cast iron fittings; the most of our air troubles have come from that, and we are cutting these out as much as possible. Recently on one of our leases there I had a loss of about 30 per cent. We had a crew of men working there night and day trying to locate this trouble, and eventually we found it during a wind storm. The rig was kind of sprung to one side and the nipple was broken beneath the ground, and the air was coming from this place, and we still had 18 inches of vacuum on this well while getting air into the line. We went over the field and checked up the line, and went back over it, and one of the men found this break. I think the best policy to pursue is to get rid of all these cast iron fittings. That is one of the troubles we have had with air.

"We have very little air trouble with expansion. Every Monday morning we go into our fields and take up the expansion. I think it is wonderful since we have been having so much surface water that we have not had trouble. That is another item that I believe we should pay more attention to. You know what trouble you have had with water getting in, I know what trouble we have had with water; we have discarded the cast iron fittings and put in gate valves entirely."

Mr. Peters: "Mr. Chairman, I would like permission to put my question a little plainer. What I am driving at is, when we send a testing car out, we make a test for air, the question is will that air content affect the yield of the gas at that time or in that way."

Chairman Ballard: "Mr. Peters' question is this, when the test car goes out to make a test and it discovers that there is a percentage of air in the gas to be sampled, does it really affect the yield, the greater yield of the gas. Some of you boys who run those cars now get up and tell him that."

Loss Is High

Mr. T. Rutherford, Victor Gasoline Company, Bristow, Oklahoma: "I cannot give Mr. Peters any definite information on it; that is, I cannot give him any figures, just what percent of air we have. I do know that on taking physical test that a small percent of air will knock the yield down all the way from 25 to 50 per cent. A few days ago I was taking a physical test on petroleum vacuum, 10 inches, and I was running on gas that I knew made a yield of about five gallons, five or five and a half gallons, and the net yield of four gallons was all I was able

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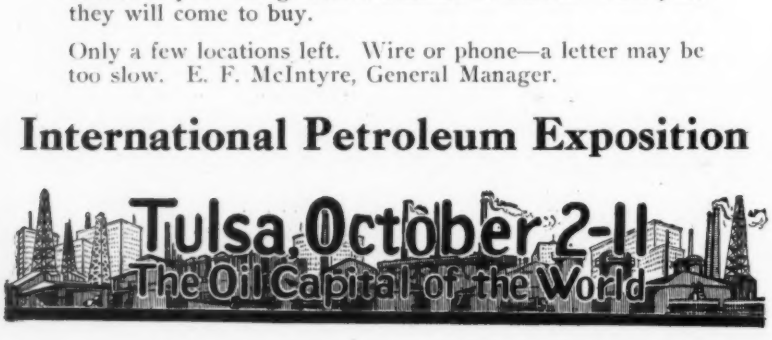
Only a few locations left. Wire or phone—a letter may be too slow. E. F. McIntyre, General Manager.

International Petroleum Exposition



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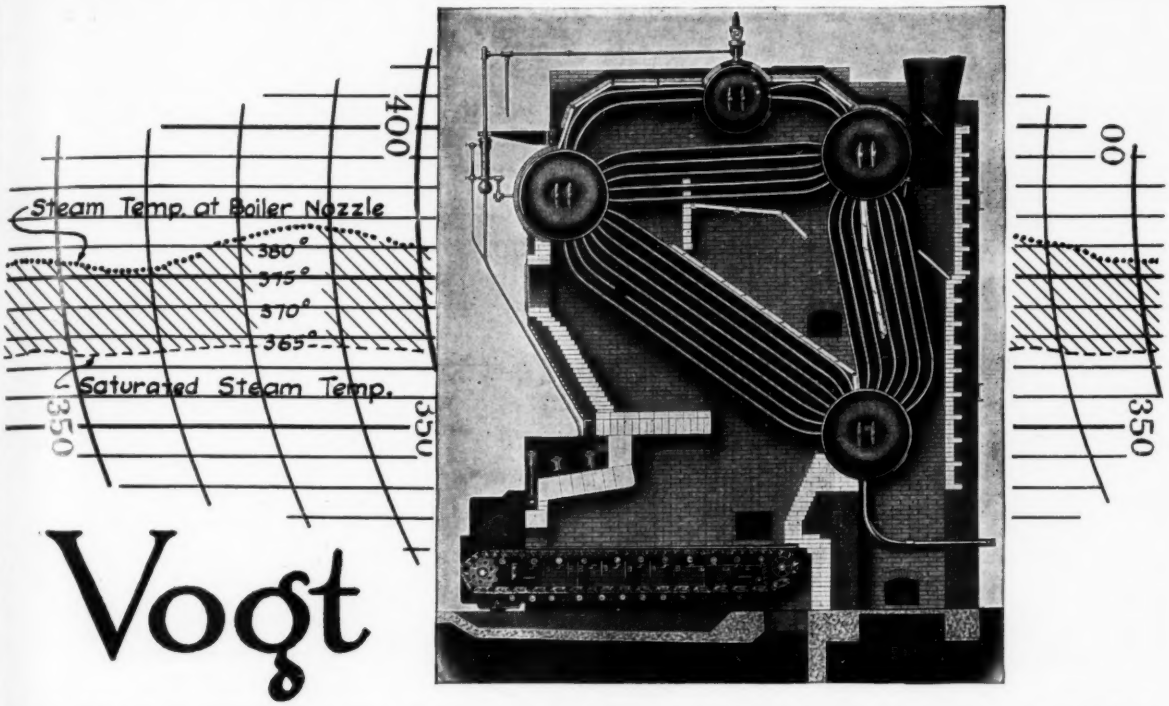

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to get out of it. I took an air test on the discharged gas from the testing machine and found that I had about 50 percent of air. I checked the line over and on this side of the physical test machine I found that I had a nipple with a small hole, it was almost invisible to the eye, and I took the nipple off and changed it and raised my gross from seven to 11 gallons and raised my net production from four to six and a half gallons. While saving 25 percent in that case knocked the yield down over 30 percent, and it will do the same thing in the compression plant, because on one plant at Drumright we have some air trouble and to get off the main subject just a little, our trouble there with the air is not so much sitting as we lay it to the oil producers, and if the oil producers cooperate with the gasoline men in the field, 90 per cent of their air trouble would cease. A crew of men will go out to blow a well, not once but hundreds of times and instead of closing the stop of the casinghead, they will take a wrench and screw the nut off of it or take a hammer and knock the nut off and leave the wrench or hammer on the floor and when the air is detected in the plant they send a crew of men out to look for it; it will take a day to find it, but the men on the line knew where the trouble was all the time.

"But getting back to knocking this yield down, 20 per cent of the air making five gallons a day will knock it down to about 25 per cent, so 30 per cent of air must knock the yield down about a third on a plant that is pulling about 24 or 25 or as high as 27 inches of vacuum, but on plants that are pulling 10 or 12 inches of vacuum it will knock the production down four or five gallons. I don't know whether there is any difference in the amount of vacuum or not."

Mr. ————: "We have our air troubles. We are operating oil absorption plants and we show a dividend in the absorption plant over the compression plant. We bring our gas into three 27 by 14 vacuum cylinders from the field; we pull normally about 20 inches of vacuum on the discharge lines coming from the field.

"If our production on 30 per cent air is normal production, under normal operating conditions, is, we will say, 8000 gallons net, and we have an increase from some cause, our average is 45 per cent, our decrease is not over three per cent because the first or low stage product as made might be very low, the gas passes from the low stage compressor, going through the absorption towers, the gasoline is taken out of the gas and the air goes on out to the field residue line; then the gas that is non-condensed in the well and the still condenser, goes from there to the re-condenser with very little air content in it, only about three to five per cent.

'In pretty near all of our production the only harm we have on increased air, the only drawback is, it pulls the vacuum that is applied, it cuts it. If we have 15 per cent increase in air, it will cut our vacuum."

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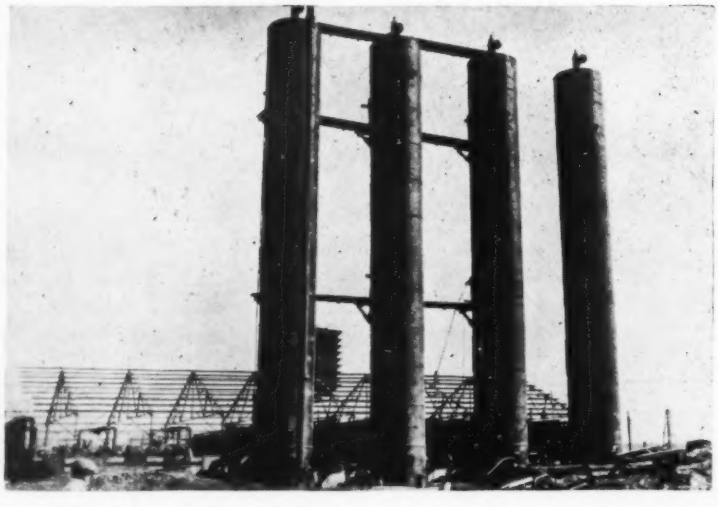

4 7'x60' Absorber Towers in Hanlon Gasoline Plant at Breckenridge

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We solicit inquiry for all classes of plate work requiring skilled and experienced construction.

Wyatt's DALLAS

Wyatt Metal and Boiler Works

Dallas, Texas

Savings Effected by Use of Stabilizer

(Continued from page 12.)

commercial application but is merely used to indicate the stability of even the most volatile fractions contained in stabilized gasoline. The portion driven off is largely butane with only small amounts of heavier fractions and as this can be blended with no appreciable loss to form a satisfactory motor fuel, it is to my mind conclusive proof of the way stabilized gasoline may be held in a finished motor fuel.

The freedom from dissolved gases results in higher distillation recoveries being obtained on the finished blend when stabilized gasoline is used, as compared to ordinary gasoline of the same distillation recovery. This increase is usually at least 1% and frequently 2%; that is where 95% recovery would have been obtained on a blend with ordinary raw, 96 or 97% will be obtained with stabilized gasoline of the same distillation recovery.

This may be expressed in another way, by saying that the same distillation recovery on the finished blend may be obtained by using stabilized raw of considerably lower distillation recovery than is possible with the same percentage of ordinary raw gasoline. Tabulated below are some tests indicating that blend containing 25% of 85% recovery ordinary raw had a distillation recovery of 96%, whereas a similar blend made of 25% of 85% recovery stabilized raw had a distillation recovery of 97%. A blend containing 25% of only 78% recovery stabilized raw had a distillation recovery of 96% or equal to that made with ordinary raw of 85% recovery. It should be noted that, in addition, the stabilized raw had higher gravities and for the same per-

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Type P-540

Capacity:
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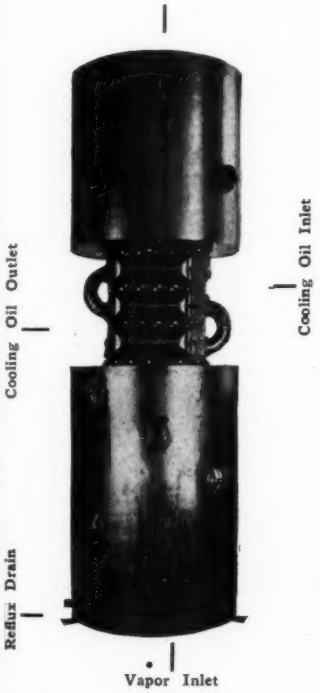
40 Bbls. Heavy Distillate, hourly.

Dimensions:
30"x30"x9'-2"

Vapors enter top of condenser and flow around tubes on inside of shell. The condensate cooled to within a few degrees of the cooling water flows from the bottom by gravity.

Cooling water enters condenser at the bottom, flows through the tubes counter-current to the downward flow of the vapors, in series, parallel or the combination best suited to the installation. Three way cocks control the flow of one or more independent cooling mediums.

"SOUTHWESTERN" DEPHLEGMATOR



Type D-180

SOUTHWESTERN construction also permits by-passing one or more units for cleaning while condenser is in operation without interfering with the operation of the rest of the condenser.

SMALL SPACE REQUIREMENTS, HIGH EFFICIENCY PER SQUARE FOOT OF SURFACE, LOW WATER REQUIREMENTS, FLEXIBILITY AND LONG LIFE OF SOUTHWESTERN EQUIPMENT HAVE COMBINED TO MAKE THIS APPARATUS IN DEMAND AMONG DISCRIMINATING PLANT ENGINEERS FOR MANY YEARS.

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centage in the blend resulted in higher gravity blends.

This brings out another point that for given gravity requirements or for specifications on the early point of the distillation, a less volume of stabilized raw may be used to obtain the equivalent result.

The tests are tabulated below:

	Ordinary Gaso. No. 1	Stabilized[1] Gaso. No. 2	Stabilized[2] Naphtha Gaso. No. 3	Naph-tha[3]	Blend[4] No. 1	Blend[5] No. 2	Blend[6] No. 3
Gr.	88.8	91.5	94.1	53.1	60.5	61.0	61.2
IBP	70	67	60	172	92	96	95
10	78	73	70	230	136	132	135
20	86	79	80	251	181	172	180
30	96	85	93	270	221	213	224
40	109	96	111	287	254	246	255
50	122	110	135	304	281	276	283
60	140	128	149	322	305	301	306
70	167	151	176	341	328	325	330
80	207	191	...	362	356	351	356
90	...	...	...	387	392	387	392
EP	260	260	260	441	437	436	436
Rec.	84.5	85.0	78.0	98.5	96.0	97.0	96.0

[1]Of equal distillation recovery to ordinary gasoline No. 1.
[2]Of lower distillation recovery than ordinary gasoline No. 1.
[3]Used in blending.
[4]Contains 25% of ordinary gasoline No. 1.
[5]Contains 25% of stabilized gasoline No. 2.
[6]Contains 25% of stabilized gasoline No. 3.

Below are tabulated some comparable distillation tests using 10, 15, 20 and 25% of a stabilized raw of 83.5% recovery with 53.1 gravity naphtha. These tests indicate that this low gravity naphtha can be made up to meet navy specifications with 20% stabilized raw, to meet all the distillation points and having a recovery of 97.5%. With 25% of stabilized raw, a gasoline superior to navy specifications is produced having a gravity of 61.0 and a distillation recovery of 97%. The tests are as follows:

	Stabilized Gasoline	Naphtha	Blends containing various percentages of Stabilized Gasoline 10%	15%	20%	25%
Grav.	91.5	53.1	56.2	57.4	58.7	61.0
IBP	56	170	120	115	110	102
10	68	230	190	171	162	140
20	76	255	229	216	200	185
30	85	271	256	248	236	224
40	97	286	274	270	263	254
50	112	300	293	289	284	278
60	134	316	311	307	304	299
70	162	331	328	325	324	319
80	222	352	352	349	348	346
90	...	381	384	382	382	376
E.P.	286	440	440	436	435	433
Rec.	83.5	98.5	98.0	98.0	97.5	97.0

To indicate what may be done with stabilized raw even of low distillation recovery, I am showing below results of two blending tests in which stabilized gasoline of 74.0 and 75.5 recovery were used to make 58/60 navy gasoline out of 53 gravity naphtha. You will note that even with 17 and 20% respectively of this high gravity, low recovery stabilized gasoline that it is possible to make a finished navy meeting all distillation points and having a distillation recovery of 97.5%. The tests are as follows:

Percentage Used	Stabilized Gasoline	Naphtha	Gasoline
	17%	83%	100%
Gravity	92.4	53.3	59.1
I. B. P.	60	165	95
20%	84	253	205
50%	156	296	283
90%	...	383	386
End Point	250	439	434
Recovery	74.0	98.5	97.5
Percentage Used	20%	80%	100%
Gravity	93.8	53.0	59.9
I. B. P.	60	218	108
20%	76	260	209
50%	113	294	278
90%	...	376	371
End Point	250	430	423
Recovery	75.5	98.5	97.5

This higher distillation recovery possible with the use of stabilized raw is very important to the efficient refiner making navy gasoline. The refiner using tower equipment that permits of close fractionation, usually finds that the 90 per cent point rather than the end point is the controlling factor in his navy gasoline. Where the refiner uses ordinary natural gasoline that would produce a distillation recovery of 95 per cent on the finished blend, there is 5 per cent remaining to boil off between the 90 per cent and the end point. Where stabilized raw is used and a distillation recovery of 97 or 98 per cent results, there remains 7 or 8 per cent to boil off between the 90 per cent point and the end point. Hence, within the limits of the end point, more heavy fractions may be included in the latter case and still meet the 90 per cent requirement. This is an appreciable advantage in increasing the total yield from the crude of material entering into navy gasoline.

Although not measurable until the end of the test, the distillation loss actually occurs almost entirely at the beginning, so that if the distillation loss is reduced, the percentages at given temperatures in the early part of the distillation, say 212 or 221°F., are increased proportionately. This is of in-

(Continued on page 29.)

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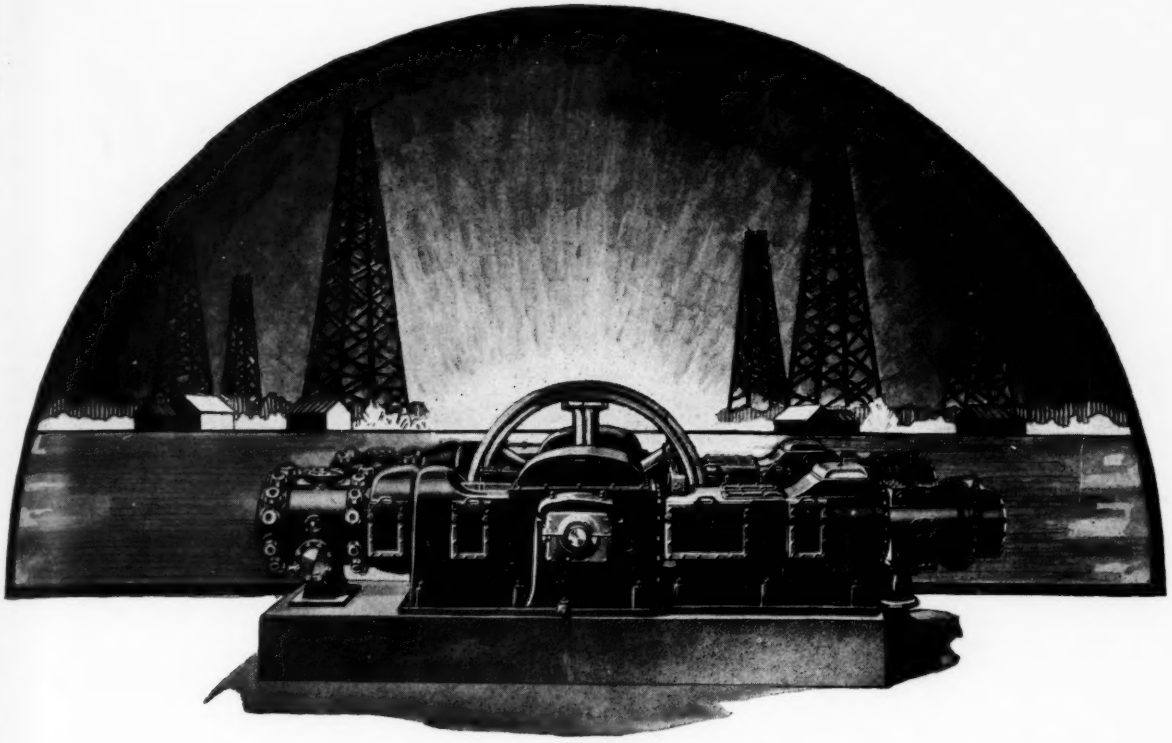

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They weren't satisfied that Sterling Sections would withstand the rapid expansion and sudden contraction caused by the quick changes of temperature of water in the condenser box.

A test installation of Sterling was made, the still operated at maximum load, with a nominal supply of water in the box. The cold water supply was entirely cut off and the same water remained in the box for three hours and a half.

At the end of this period cold water was pumped into the box as fast as the pump could work, the still carrying the same maximum load. Not a single fracture resulted from this heating and rapid cooling.

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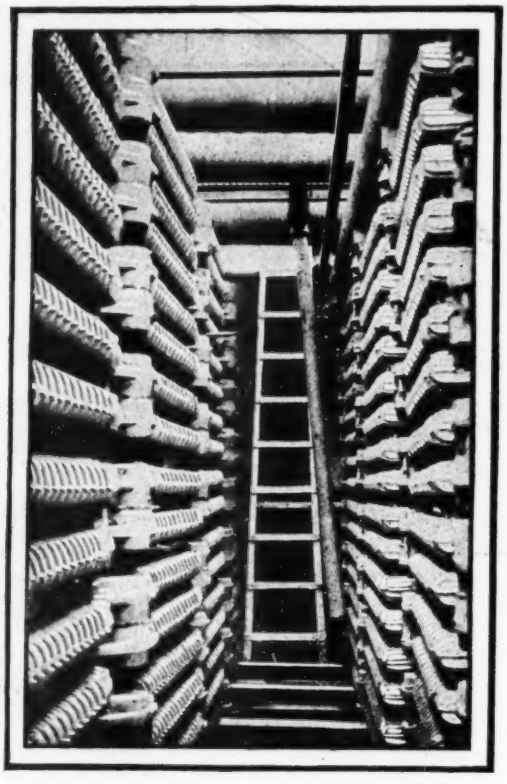

Condenser Box in Plant of Champlin Refining Co., Enid, Oklahoma

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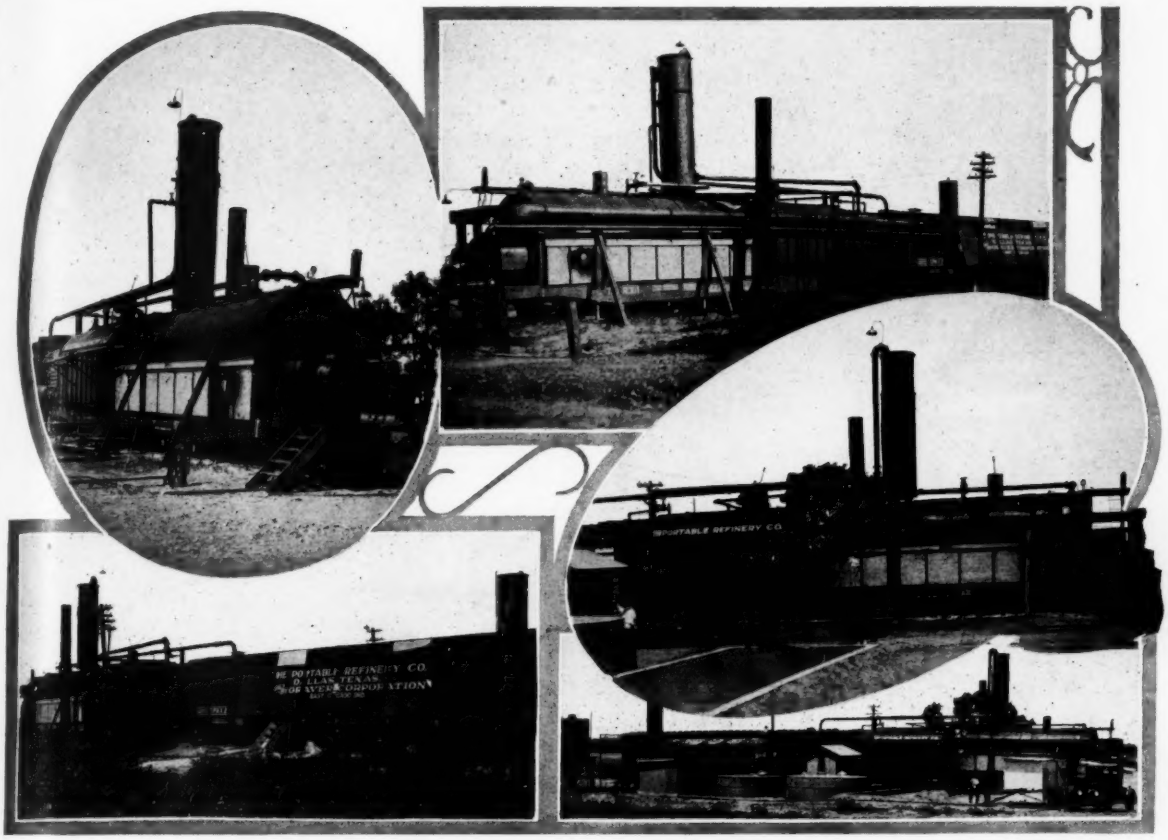

Views showing the portable refinery. The two top scenes show the outfit as it looks when loaded on the cars. The bottom cuts show the refinery from different sides as it looks when set up ready for operation.

Compactness Makes for Portable Plant

Refinery at Luling operates on wheels— Can be moved quickly to source of crude

MEETING oil on its own grounds has truly been accomplished by The Portable Refinery Company of Dallas, for that company has in operation a refinery that goes wherever it is needed. At this time, the plant is in operation by the Mutual Pipe Line Company, near Luling, Texas, and is topping between 2,000 and 2,500 barrels of crude from the Luling field, daily.

Several revolutionary features in the operation of a crude oil refining plant, representing increased efficiency and economic saving are embodied in the outfit: First of all, the refinery is just what its name implies — a portable crude oil refining plant. Its equipment is carried on specially built steel railway cars, being permanently attached to and operated from these cars. The plant may be moved from one oil field to another with virtually no loss in salvage. When a new oil field is discovered, the outfit can be rushed across the country to that field by rail, intact. The process of moving consists simply of dismantling detachable equipment, such as pipe connections, smake stack and rectifying tower, coupling up the two steel cars carrying the permanently attached equipment to a freight train, and consigning the plant to its new destination.

Within 8 or 10 days after the cars on which it is built are spotted, the refinery can be put into operation. Four or five days are required to dismantle connections and place it enroute again when it is desired to move.

Equipment

Flue type still of the kind used in the distillation of tar is employed with forced air draft for heating. This type of still has never been used before for refining crude oil. A Dutch oven at the front of the still supplies heat for the refining process this oven being equipped with two fuel oil burners. Two flues, 24 inches in diameter and 30 feet long, the length of the still, extend longitudinally through the still. After the flame and heat have passed through these flues, they are returned through air-tight compartments along the sides of the still and then pass under the still through another passage way and on to the smoke stack. More than one-half of the surface of the still is brought into contact with the heat through this system, making the heating process very rapid.

The vapor condensation process is one of the most extraordinary features of this refinery. Air instead of water is used to cool the condenser, the air being drawn through the space between the coils by a large suction fan 70 inches in diameter. Air is also used to atomize the fuel oil for the burners and for combustion. Compressed air is also used as starting power for the big Bessemer engine. The compressor that fills the air tank with this bottled power, is operated by a 2-horse power gas engine.

Operated by Electricity

The refinery is electrically operated throughout, the use of steam being entirely eliminated. The electric generator is operated by 70 horse power Bessemer fuel oil engine, furnishing power for the pumps and current for lighting the plant.

The equipment of the refinery is complete in detail, everything necessary for its operation being carried on the two big cars and additional cars of ordinary make necessary for the de-

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tachable equipment, such as pumps, tanks, pipe connections and the like.

The rectifying tower and the smoke stack of the plant are also detachable, being placed in position after the plant is located for operation.

Capacity

The refinery has a capacity ranging from 1,000 to 3,500 barrels of crude in 24 hours. It can handle 250 barrels to the run. Distilling off 60 per cent of the crude, it can handle 1,000 barrels in 24 hours in six hour runs of 250 barrels to the run.

Power equipment and distilling equipment, the two main units of the plant, occupy the specially built railway cars. These cars are 65 and 70 feet long. The longer car is the power car and carries the 70 horse power Bessemer engine, 70-inch diameter suction fan, air compressor and 2-horse power engine to operate it, air tank, radiator for cooling water to cool engine, low pressure blower to atomize fuel oil for burners in the oven of the still, and electric switchboard and other equipment. The still car carries the still, heat exchanger and condenser. The rectifying tower is mounted on top of the still after the car is spotted, and the smoke stack is placed on a concrete foundation at the side of the still car.

Both the big railway cars are built to conform to standard railway specifications. The power car has a capacity or traveling load of 80,000 pounds, while the still car has a capacity or traveling load of 100,000 pounds. When the plant is in operation, the still car has a working load capacity of more than 300,000 pounds. The fire brick walls that inclose the lower half of the still are erected after the plant is located. These walls can be removed on moving the plant, thus effecting a saving in freight charges.

When the plant is in operation, the specially built cars do not rest on their wheels. Instead they are supported by concrete foundation beams built under the cars. The cars are jacked up on being spotted at the point of operation and lowered onto these concrete foundation supports.

The 70 horse power Bessemer engine, the main power unit of the plant, is a Type IV, single cylinder, valve slide engine. Its operation is very economical, requiring only 2¾ to 3 barrels of fuel oil in 24 hours. At the present rate of $1 per barrel for fuel oil, this makes the cost of operating the engine not more than $3 per day.

Two men to the shift can operate the refinery. The plant was put into operation at Luling during the early part of April. Through arrangements made with the Portable Refinery Company, the owner of the plant, it is being operated at Luling by the Mutual Pipe Line Company.

Built by Graver

The plant was built by the Graver Corporation, of East Chicago, Indiana, for the Portable Refinery Company, of Dallas. Its portability feature is the contribution of T. W. Sowell, of Dallas, president of the Portable Refinery Company. The general scheme of the refinery, including the innovations in the process of refining crude oil, was designed by the Koppers Company, of Pittsburgh, Pennsylvania.

On its maiden journey, the refinery traveled more than 1,200 miles, from Chicago, Indiana, to Luling, Texas.

Will Start on Fourth Carbon Plant June 1

Breckenridge, Texas. — Construction work is to begin before June 1 on the fourth carbon black plant in Stephens County, Texas. This plant is to be erected by J. M. Huber of Monroe, La., a veteran carbon black manufacturer in the Monroe gas field, and will operate on the residue gas from the Roeser & Pendleton Gasoline Company's gasoline plant No. 1, located in the Curry pool near Breckenridge. Present plans are to build a carbon black plant with 90 burning houses capable of handling 9,000,000 cubic feet of gas daily, while an option expiring July 1 is held by Huber to purchase the residue gas from the Roeser & Pendleton Gasoline Company's gasoline plant No. 2 in the Curry pool. This new carbon black plant will cost approximately $200,000, and will probably be the last one to be erected in Central West Texas fields, as the permit was obtained last year when the other three plants now operating in the county were authorized by the oil and gas division of the Railroad Commission.

Liquified Petroleum Gas Company will shortly begin operation on its new gasoline plant in the Stroud, Oklahoma, district in Lincoln County.

The Gilliland Oil Company of Tulsa has converted its compression plant west of Barnsdall, Oklahoma, into an absorption plant, increasing production considerably thereby.

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Savings Effected by Use of Stabilizer

(Continued from page 22.)

terest to the refiner who may have specifications of his own as to minimum percentages desirable at 212°F. It has been found in extensive motor tests that the starting and acceleration characteristics are closely related to the percentage distilling at 212°F. The horse power developed or the mileage from any given car is also related to this figure. A number of refiners, who watch this point particularly, insist upon having a natural gasoline which will be retained to the maximum extent in the finished blend. They are interested not only in putting in a certain percentage of natural gasoline but in seeing that it stays there and may be accounted for in the increased percentages distilling at 212° F. Stabilized gasoline meets this requirement admirably.

As shown above, it is possible to use considerably greater percentages of stabilized gasoline than has been the case with ordinary gasoline. This permits the use of lower gravity blending stock as a basis for the finished motor fuel. Not only may somewhat heavier ends be included in the blending stock but it is usually possible to take out a percentage of high gravity, straight run gasoline from the crude for sale as such, or increase such percent if the refiner is already doing this to a certain extent. It has been found possible to increase the percentage of high gravity straight run by 3 or 4 per cent on the crude, eliminating this percentage from the navy blending stock. This increased volume of high gravity straight run amounts to approximately 10 per cent of the gasoline produced by the average refiner, and this product usually brings a premium of about 3 cents per gallon above navy gasoline. In other words, the refiner's realization can thus be raised approximately 12 cents per barrel of crude run.

As has been indicated in this paper, stabilized gasoline can be produced with distillation recoveries varying from 75 per cent to 90 per cent. The corresponding gravities at our Burkburnett plants vary from 94° to 86° A. P. I.

In the rather limited time that the stabilizer has been installed in our plants, this interesting data on its operation and the application of its products have been developed. Primarily, of course, it has been dependent upon the excellent research work and consequent mechanical design of the Carbide and Carbon Chemicals Corporation. I do not wish to leave the impression that all possible applications of the stabilizer have been exhausted, for I believe there are a number of profitable channels yet to be investigated. However, the basic principle involved in freeing natural gasoline from all gaseous constituents and including any desired percentage of butane is of the upmost importance and in all probability the only principle under which maximum yields may be obtained.

Cosden and Company is to construct an absorption plant in the Wetumka field in Northern Hughes County, Oklahoma.

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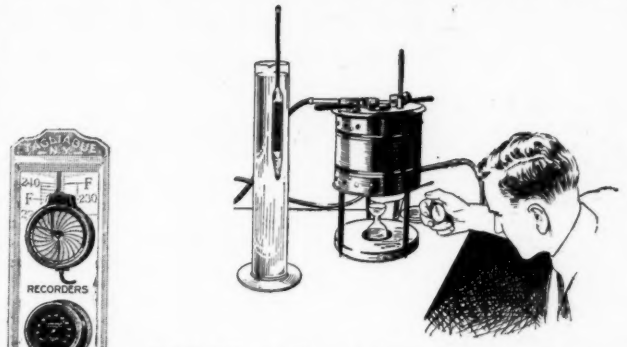

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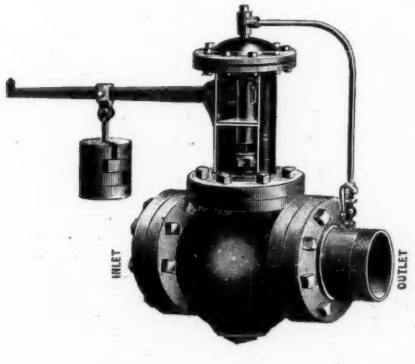

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Recovering Uncondensed Still Vapors

Large saving of gasoline effected by using auxilliary absorption or compression plants

*By D. B. Dow**

U. S. Bureau of Mines, Experimental Station Bartlesville, Oklahoma

THIS paper covers briefly the results of a study made by the Bureau of Mines on one phase of refining practice—the recovery of gasoline from uncondensed still vapors. While this deals entirely with a refining problem rather than with the manufacture of natural gasoline, it is to be noted that the processes utilized by the refiner for this work were adaptions of processes developed by the natural gasoline manufacturer. As a matter of fact in one refinery visited by the writer, a small compression plant operating on uncondensed still vapors was referred to as the "casinghead plant." This was before the advent of the term "natural gasoline," and incidentally shows the extent of misuse of the name "casinghead gasoline."

Increasing Gasoline Yield

This paper aims to show the possibility of increasing the gasoline yield from the crude by the recovery of considerable gasoline that is now lost by remaining uncondensed. This loss will tend to become larger in the future because, on account of the growing tendency to eliminate evaporation losses in handling crudes in the field, refineries will receive crudes containing much lighter and more volatile fractions. The magnitude of the losses resulting from non-condensation of still vapors has been realized by only a small proportion of the refiners and comparatively few plants have installed recovery systems.

In 1920 the 13 refineries studied in collecting data for this report were obtaining 128,651 gallons of gasoline daily by recovering the gasoline contained in uncondensed still vapors. These plants are situated in various refining centers other than on the Pacific coast, and are running crudes that represent all the producing fields of the United States east of the Rocy Mountains. In addition several are running Mexican crude. Information from refining companies in California indicates that at that time, because of the smaller gasoline content of the crudes received, there are no large plants for recovering uncondensed still vapor in that state.

Uncondensed Vapors

Vapors remaining uncondensed after passing from the still through the condenser are generally classified under two heads, "sweet gas" and "sour gas." The term "sweet gas" refers to those vapors remaining uncondensed during the distillation of the lighter ends of the crude. In the batch process these vapors are formed from the light and heavy naphthas; in the continuous process they come from the first few stills of the battery, as these remove the light and heavy naphthas. The term "sour gas" refers to vapors formed by cracking, either in tar stills or in pressure stills; the term is very descriptive because cracked gases are largely unsaturated and have the marked odor peculiar to cracked products. This odor is due in part to the sulphur compounds usually present in cracked gases.

The distillation process used not only governs the properties of the gas but also the amount that is formed from a definite amount of crude. A skimming plant that removes only gasoline, kerosene, and gas oil will not produce the same amount of vapor as a plant that is equipped with pressure stills or one that is producing comparatively large quantities of cracked gases in distilling down to coke.

Vapors in Skimming Plants

In skimming plants practically all the vapors that remain uncondensed are formed during the distillation of the first 15 per cent of the crude. After this fraction has been removed, the vapors consist largely of hydrocarbons that can be easily condensed at the temperatures maintained in the ordinary condenser. In addition to the uncondensed vapor from the crude stills, large quantities of vapor remain uncondensed when the naphtha fractions are rerun in the steam stills.

With these two sources of gas, it is rather inexpensive to install gas lines to remove the vapors as rapidly as formed. The problem of collecting the vapors is correspondingly simple, for the lines from both sources can be joined and taken to a central point where a small vacuum is held.

The gas can be treated either by the compression or absorption process. There is generally no need for "scrubbing" to remove sulphur, as the sulphur content of the gas from the naphtha fractions of the crude is low and is not objectionable. The gas is nearly all gasoline vapor, containing no appreciable amount of permanent gas; tests have shown it to contain as much as 30 gallons of gasoline per 1,000 cubic feet of vapor.

Vapors in Refineries With Pressure Stills

In refineries operating pressure stills the conditions are different from those at skimming plants. Uncondensed vapors are obtained not only from crude and steam stills but also from pressure stills. Large amounts of rich uncondensed vapor are also obtained from the rerunning of pressure-still distillate, which yield as high as 24 gallons of gasoline per 1000 cubic feet. Experiments have shown that in running a barrel of Cushing crude about 52 cubic feet of vapor remains uncondensed. Under the same conditions of condensation a barrel of gas oil distilled under pressure gave 163 cubic feet of gas with an average gasoline content of 2.8 gallons per 1000 cubic feet.

As the sources of gas are more widely separated, the problem of installing a recovery system in a refinery of this kind is much more complicated than in a skimming plant. In the latter, the gathering line takes only from the crude stills that are running light distillates and from the steam stills; whereas in the complete refinery, the gases are obtained from crude, steam, pressure, and rerun stills. The larger number of sources involves a much more extensive system of gathering lines, and careful provision must be made for covering distances longer than those in skimming plants. If the gases are all collected by one central exhauster, as is usually done, there is danger of too high a vacuum being held on the stills; through the frictional resistance of the lines and the small amounts of gas produced those stills at longer distances may be under no vacuum at all.

Sulphur must generally be removed in a refinery that uses pressure stills because the hydro-carbon sulphur compounds are broken down at the existing temperatures and pressures. To avoid considerable trouble from subsequent deposition of sulphur, rather large expenditures must be made in providing scrubbers for sulphur removal.

Effect of Atmospheric Temperatures

Atmospheric temperature is an important factor in connection with the production of gasoline from uncondensed refinery vapors. During winter months, when condensation of the vapors is more nearly complete, the production of the "gas" plant falls off somewhat. An unusual example of this is one skimming plant that produces about 6000 gallons of compressing gasoline a day through the summer but only 500 gallons a day in the winter. Ordinarily the difference is far less, but at all plants the production tends to drop in cooler weather. Another factor that tends to reduce the winter production of those "gas" plants that recover the gasoline from the vapors of storage tanks is the lessened evaporation in those tanks during the cold weather.

Three other factors that determine the gasoline content of the uncondensed vapors are the nature of the still charge, the temperature of the stream, and the vacuum carried on the run-down lines.

The distillates from crude oil containing only a small proportion of low-boiling fractions condense readily; and the loss in uncondensed vapor from this type of crude is low, as compared with the losses from a crude with a high gasoline content. Likewise the amount of vapor remaining uncondensed during the distillation in the steam still depends upon the nature of the charge. For example, a light naphtha forms more gas than a heavier distillate.

The vacuum carried on the run-down lines influences the yield of vapor, since any increase in vacuum causes a

*Dow, D. B.—U. S. Bureau of Mines Technical Paper 310, Recovery of Gasoline from Uncondensed Still Vapors. 1923, 53 pp.

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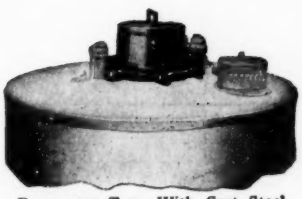

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corresponding decrease in the boiling points of the distillate. The vacuum carried should be as low as possible and serve only to remove the vapors formed, rather than to lower the boiling point of the charge being distilled.

Temperature of Stream

The temperature of the stream is an important factor, for any increase in the temperature of the distillate causes a corresponding increase in the gasoline content of the gas. The temperature of the stream depends in turn on the temperature of the cooling water in the condenser and on the rate of distillation. The amount of condenser surface per gallon per hour is determined by these two factors. For light fractions the condenser surface is generally about two square feet per gallon per hour. If this figure is lowered the gasoline content of the vapors becomes higher, and if it is raised the gasoline content becomes lower, provided, of course, that the temperature of the cooling water is constant.

Results Obtained

In representative refineries on the Atlantic coast, the Gulf coast, and in Oklahoma, Wyoming and Kansas, that have installed plants for the recovery of gasoline from uncondensed still vapors, it was found that in these plants the recovery of gasoline ranges from 0.05 gallon to 0.84 gallon per barrel of crude charged. In several plants where the recovery is low, the refineries do not have the most efficient type of plant, and in others the refineries are not fully equipped for taking care of all the gases formed.

In some of the refineries included in the study, low recoveries were due to the low gasoline content of the crude and to the absence of pressure stills. Other refineries having pressure stills did not utilize the cracked gases because of lack of equipment for removing the large content of sulphur compounds.

The total crude oil charged to the refineries visited in this study, amounts to 355,486 barrels per day. By the use of the recovery system for the uncondensed still vapors a total daily gasoline yield of 128,651 gallons is obtained, an average recovery of 1.05 per cent or 0.444 gallon of gasoline for every barrel of crude oil charged. Unless the recovery system was used, this gasoline would be lost or be burned as fuel under the stills and boilers.

Removal From Run-down Lines

In the distillation of crude petroleum the first vapors or gases driven off are naturally the lightest and have the highest vapor pressure of all the hydrocarbons present in the crude. In order to condense these vapors it is necessary for the cooling surface of the condenser coils to be large and held at a low temperature.

Under these conditions all of the vapors would condense except the very lightest, which might properly be called permanent gas rather than gasoline vapor. Almost all of the small amount of gas left uncondensed would be almost dissolved in the condensate. Ordinarily, however, the temperatures of the condenser boxes are so high that a large part of the first few per cent distilled remains uncondensed. By removing these vapors as rapidly as they are formed, and by submitting them to subsequent compression and cooling, or by dissolving them in a low-gravity oil, a large part of the vapors can be recovered as gasoline.

Vapors can be removed from the run-down lines at any point after they have received the maximum cooling effect of the condensers. In some plants they are taken from the bottom of the coil by a riser passing upward through the water in the condenser box. This is less desirable than where the gas is taken off outside the condenser box, which cuts down repair costs. More frequently, however, the gases are removed from the run-down lines at the "tail house". Usually a gooseneck or trap is placed between the gas-gathering line and the "lock box" to prevent air from being drawn into the line from leaks in the latter. At many of the plants a small vapor line leads from the lock box to the gathering line, although in most of them the line from the lock box discharges directly into the atmosphere, because only a little gas comes from the lock box, and any leakage in the lock box would result in this small volume of gas being diluted with air.

The risers from the bottom of the worm or from the gooseneck differ in diameter with the volume of gas they are expected to handle; they generally are not less than 1¼ inches and range up to 3 inches. In a large plant with several tail houses the small risers enter a larger line, which in turn dis-

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charges into a still larger main line that leads through the trap to the gas plant.

A vacuum is held on these lines and is regulated to remove the vapors as rapidly as formed. In one plant visited this vacuum was as low as one-half inch of water and in another as high as 6 inches of water. For best general operation 1 inch of water would probably be enough; higher vacuums cause the evaporation of considerable gasoline that has been condensed in the coils and may put the still under a vacuum, which is to be avoided. In addition, higher vacuums may cause much trouble by drawing air into the lines. In some refineries vacuum valves are used which open and allow air to enter when the vacuum or any unit becomes too high. Other plants have in place of this valve a small "clapper" valve on the top of each header. This valve serves the opposite purpose—if the pressure of the still builds up until it exceeds that at which the vacuum line has the capacity to handle the excess vapor, the valve opens and allows the vapor to escape.

Traps on Gathering Lines

In building a recovery system for uncondensed still vapors it is well to install traps between the exhauster, or the tanks of the compressor, and the source of the gas. These traps serve several purposes. They remove condensate caused by air cooling and any heavy products carried over mechanically which would ruin lubrication on entering the exhauster or compressor; they equalize pressure, preventing sharp changes of pressure in the run-down lines, and serve to remove sulphur compounds.

Form of Traps

In the different refineries visited these traps were practically of the same type, consisting of a steel tank from about 4 feet in diameter by 5 feet high to 15 feet in diameter by 18 feet high. In these traps the gas receives a preliminary washing with water, which removes sulphur, any naphtha that may have been condensed, and any heavier hydrocarbons carried over mechanically.

Various devices for washing are used. The simplest is a gas inlet line entering below the water level. The more complex have inside the inlet pipe a small water line with drilled holes, which sprays the gas before it passes through the water seal.

At some plants traps are placed in every "tail-house", and at others one large trap is installed in the exhauster house. At one refinery visited, where a trap was installed at each unit, a steel tank 15 by 18 feet is used. A 12-inch gas intake line enters the top and drops to within 3 feet of the bottom; the gas, after being washed by a spray, bubbles upward through the water. The washed gas leaves the trap at the top through a line that goes directly to an exhauster.

Use of Exhausters

The mechanical problems involved in collecting uncondensed vapors are much more complex at complete refineries than in skimming plants, for at these uncondensed vapors are gathered from a small number of crude stills and steam stills. The recovery systems installed in complete refineries are necessarily much larger and much more complicated, because the wide separation of sources of gas makes the carrying of the same vacuum on all run-down lines difficult. Skimming plants taking crude charges even larger than those taken by complete refineries have a smaller number of stills, and hence shorter and less complicated gathering lines. In a skimming plant of this type an exhauster is not necessary, as the vacuum needed for gathering the vapors can be developed by the intake of the compressor.

In complete refineries, however, where pressure stills, lubricating stills, rerun stills, steam stills, and crude stills are all used, the area of the plant is much larger, the gases formed differ greatly in composition and volume, the pressures vary over wide limits, and the gathering lines are more complex and much longer. Hence the installations made must permit the gathering of different gases and yet not permit pressure to build up in any still that is generating a large amount of gas nor a vacuum to come on a still that is making very little gas.

Advantages Gained

Positive-pressure rotary blowers or exhausters are used for gathering uncondensed vapors. They can handle large volumes of gas, hold the run-down lines under a vacuum of 1 to 4 inches of water, and discharge at a pressure high enough to force the gas

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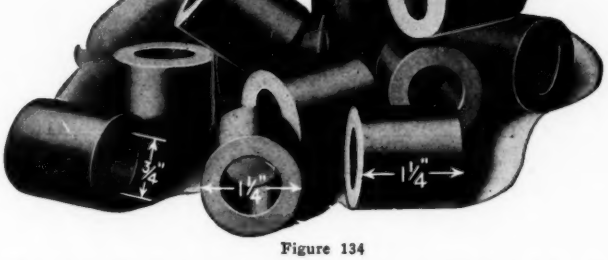

Figure 134

Small Tube, or Ring, Tower Packing

One size only shown in illustration but are made in the sizes listed below, or any size you may desire, in either glazed or unglazed body as preferred.

Sizes	Per Cu. Ft.	Wt. Cu. Ft.
5/8" lg., 5/8" dia., 3/8" hole	3200	60 lbs.
3/4" lg., 3/4" dia., 3/8" hole	2800	57 lbs.
1 " lg., 1 " dia., 5/8" hole	1200	57½ lbs.
1¼" lg., 1¼" dia., 3/4" hole	700	50 lbs.
1½" lg., 1½" dia., 1 " hole	500	45 lbs.

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through the sulphur scrubbers. Reciprocating machines and fans are not recommended for this work.

In refineries that use cracking stills the presence of sulphur compounds in the vapors give much trouble. Skimming plants have less trouble from sulphur, and consequently do not have to provide for removing it from the uncondensed still vapors.

The magnitude of the problem of sulphur removal is determined largely by the nature of the crude, for different crudes have a widely different sulphur content. Some Mexican crude runs as high as 5 per cent sulphur; California crudes range from 0.34 per cent to 3.55 per cent; 1.75 per cent is typical for Gulf coast crudes, whereas Oklahoma and North Texas crudes carry about 0.4 per cent, except Healdton crude, which has only 0.76 per cent. Pennsylvania crude is exceedingly low in sulphur, only about 0.06 per cent, whereas Lima, Ohio, crude carries 0.65 per cent. Canadian crude runs as high as 1 per cent.

Decomposition of Sulphur

In the fractional distillation of crude oil the temperatures and pressures used do not break down these sulphur compounds enough to cause the deposition of much free sulphur in the lines carrying the vapors to the gas house; generally the sulphur compounds are dissolved in the distillates and are removed by chemical treatment. These sulphur compounds that remain in the vapors are not ordinarily considered of enough importance to warrant the installation of scrubbers. In refineries where pressure stills are used or where crudes of rather high sulphur content are refined, however, the temperatures and pressures are such that these sulphur compounds are broken down more completely. That decomposition of sulphur compounds takes place is evidenced by deposits of free sulphur on lock boxes and by sulphur dust which, if not removed, fills up the lines, blowers, and valves of the gas plant. The writer has seen a two inch cast iron T as completely filled with sulphur as it would have been had the sulphur been melted and poured in.

As stated before, the character of the crude determines the amount of sulphur in the vapors. In several refineries where varying amounts of Mexican crude are handled the sulphur content of the uncondensed vapors ranges between 600 and 3000 grains of sulphur per 100 cubic feet of gas.

Use of Lye Scrubbers

Several methods have been used for removing sulphur from uncondensed still vapors. The one that probably is in widest use is scrubbing the gas with a lye solution after its discharge from the exhauster. In this method the gas is passed countercurrent through a series of scrubbers filled with wooden baffles. Water scrubbers remove the free sulphur and dissolve some of the hydrogen sulphide; then the gas passes into a lye scrubber, which contains a solution of caustic soda made up to 15°B. (1.115 sp. gr.), where the hydrogen sulphide and other sulphur compounds are removed. A final water scrubber removes any alkali that might be carried over from the lye scrubber.

A plant on the Atlantic seaboard using this system has six tower scrubbers 20 feet high and 4 feet in diameter connected in series. These scrubbers are filled with wooden baffling of 1-inch by 6-inch boards, supported by an angle iron riveted inside the tower. The gas enters each scrubber 2 feet from the bottom and passes up counter current to warm salt water (about 5° warmer than the gas) pumped directly from the condensers. The higher temperature of the water serves to keep any of the gasoline in the vapor from condensing. The water used is salt because it is sea water which is available in unlimited quantities. Its salinity is of no advantage, in fact the sodium and magnesium compounds promote corrosion and are detrimental to the steel in the towers.

The gas is taken from a line 4 inches from the top of the scrubber and enters the next in series 2 feet from the bottom, passes through four of these water scrubbers, and then into a lye scrubber. From this tower the gas passes into the sixth and last scrubber where warm sea water washes the vapors and removes any lye carried over mechanically. The water and lye are circulated by duplex pumps, the lye being recirculated until the absorbing efficiency is lowered to the point where fresh lye is required. The source of the crude again becomes a factor since, according to the men operating the plants, lye does not absorb sulphur from the vapors of Mexican crude as

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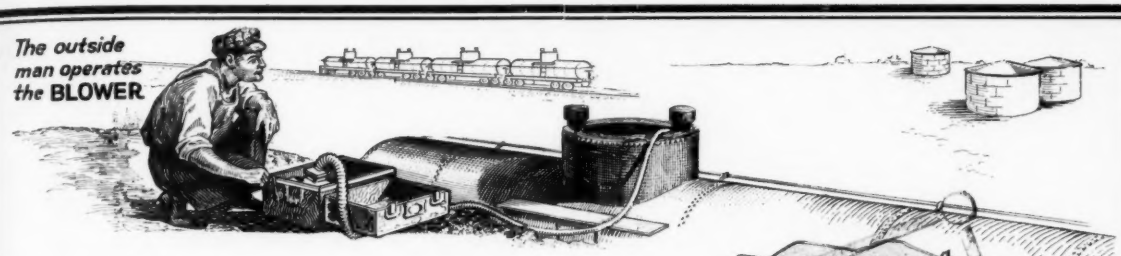

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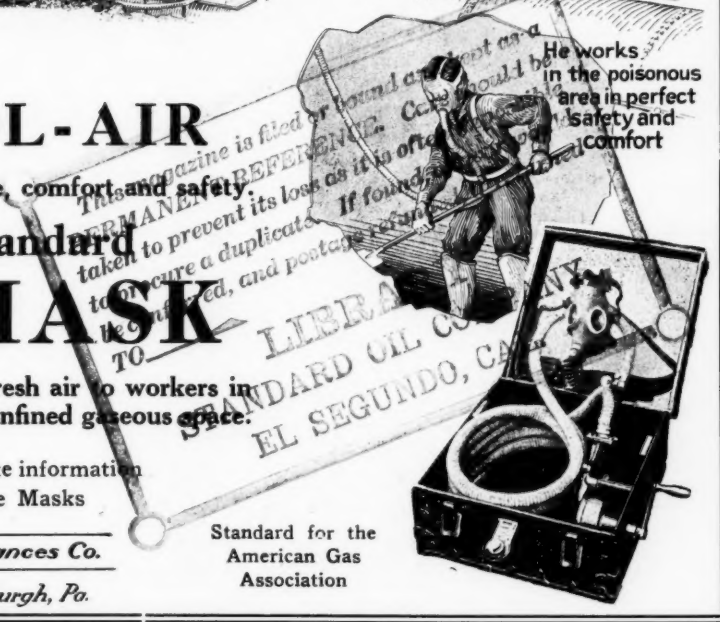

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readily as it does from Mid-Continent crude.

Chemicals Required

In this plant twelve 600-pound drums of sodium hydroxide (lye) made up with water to 15°B. treats 1,500,000 cubic feet of vapor a day and lasts 3 to 4 weeks. The crude refined is 20 per cent Mexican of 22° A. P. I., 60 per cent Mid-Continent of 33.4° A. P. I., and 20 per cent Pennsylvania crude of 41.5° A. P. I. A fresh solution of lye lowers the sulphur content from about 3,000 grains per 100 feet of gas to about 60 grains per 100 cubic feet, but this efficiency drops rather rapidly. Blowing the lye with air revivifies the charge and greatly increases the life of the solution.

Iron Oxide

A second method of removing sulphur from the gas is by the use of iron oxide. This method is not employed as widely as the lye method, but certain advantages are bringing it into more general use. The gas is scrubbed with iron oxide suspended in water by agitation with air; the sulphur is removed from the gas and is changed to an iron sulphide. The air not only keeps the iron oxide in suspension, but helps to revivify it by supplying air for converting iron sulphides to iron oxides.

Method of Recovering Gasoline

The uncondensed still vapors may be treated in several ways to recover the gasoline vapors present. By compression, in which method the vapors are compressed and cooled and the gasoline precipitated as a liquid; by absorption, in which an absorbing oil brought into contact with the vapor selectively absorbs the heavier hydrocarbons from the lighter (permanent gases); or by a combination of the two methods, in which an absorption system treats the residual gas from a compression plant.

In the combination of compression and absorption methods, the discharge gas from the compression plant is washed with 50° A. P. I. naphtha. This naphtha is blended with the raw gasoline obtained by compression.

Compression Process

The compression process is used more widely for recovering gasoline from refinery gases than is the absorption process. As the compression process was first developed for recovering gasoline from casinghead gas, and as uncondensed refinery vapors are much like casinghead gas, its application in the refinery was a natural development.

The compression process is well suited for recovering gasoline from uncondensed still vapors, as the gasoline content is high, and extremely high pressures are not necessary to recover the larger part of the gasoline present. At the many refineries using this method the highest pressure the writer noted did not exceed 200 pounds, and most of the plants used pressure below 100 pounds per square inch. This is to be expected because the gases treated are almost entirely gasoline vapors and contain but a little permanent gas. Only a few plants compressed in two stages, the greater number used single-stage compression entirely, and relied on a naphtha-absorption system for recovering any gasoline in the residual gas. The naphtha was used in blending the compression gasoline.

In the smaller recovery plants the intake on the compressor can carry the required vacuum on the run-down lines, thus eliminating the need of an exhauster. Although the initial cost of a plant for removing the vapors in this way is lower than that of a plant using an exhauster, the method frequently gives considerable trouble, and hence requires continuous supervision. If the intake of the compressor is used for removing the gases from the run-down lines, the vapors treated are restricted to the sweet gases, those of very low sulphur content. When the sulphur content is high, scrubbing to remove sulphur is absolutely necessary, and as this scrubbing must be done before the gas reaches the compressors, an exhauster is needed to carry the vacuum and to discharge at a pressure high enough to force the gas through the sulphur scrubbers. Several refineries are treating sweet gas only and carrying the sour gas in separate lines to the boilers, where it is burned without the gasoline being removed. Use of an exhauster and a system of sulphur purification would greatly increase the output of this type of recovery plant.

Absorption Process

In the absorption process for recovering gasoline from uncondensed still vapors the vapors are brought into intimate contact with absorbent oil, which takes into solution the gasoline and some of the permanent gases in the

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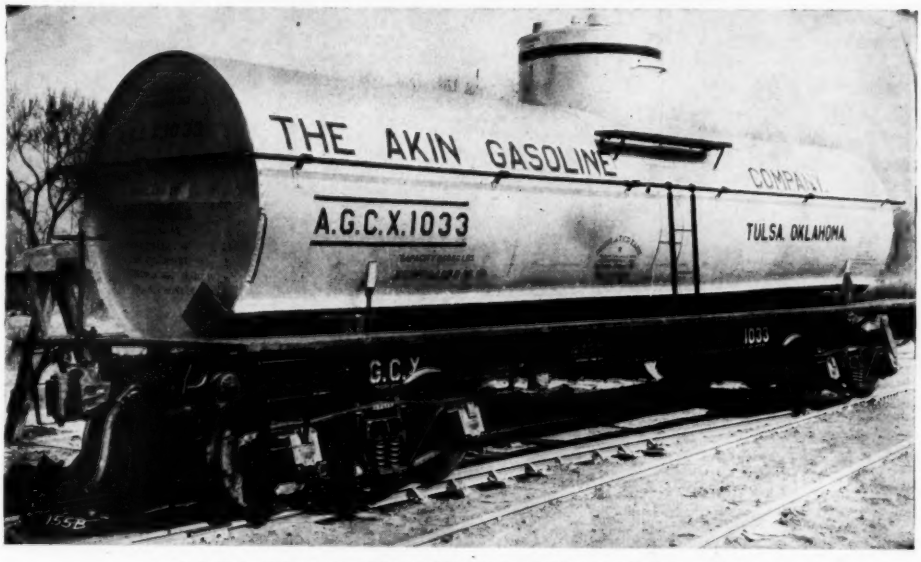

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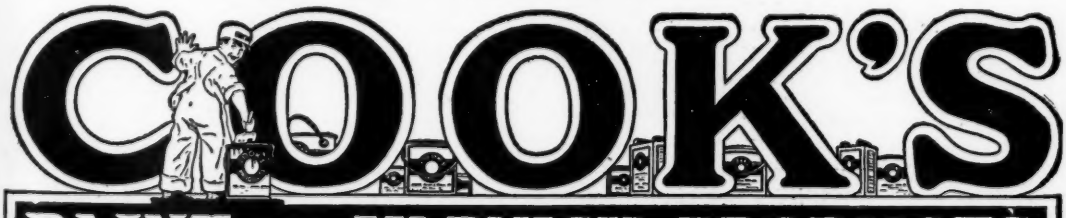

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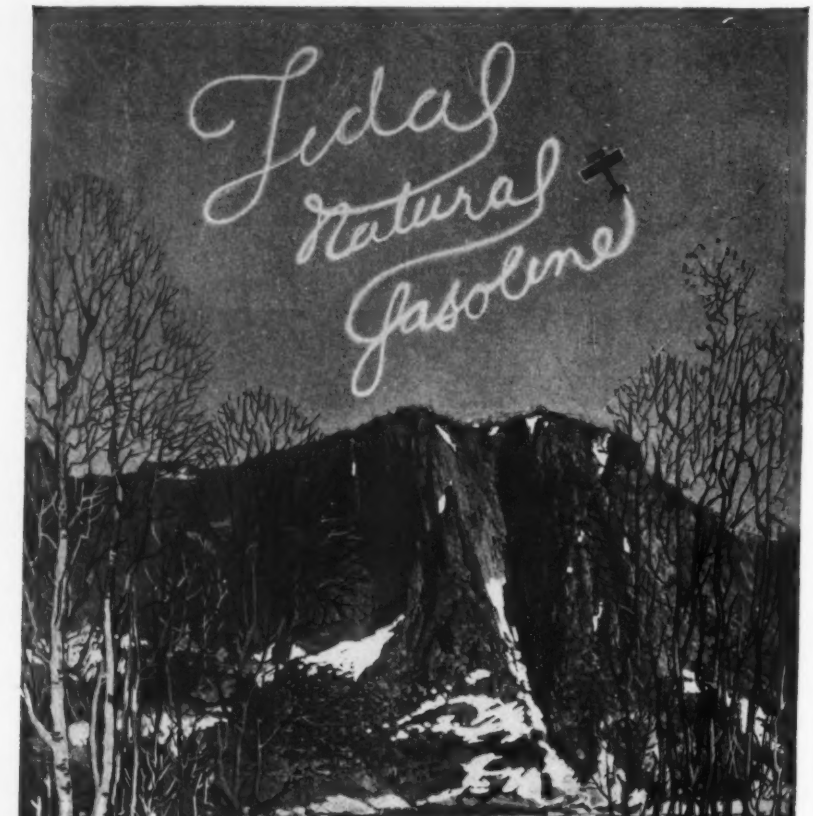

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vapors. When a naphtha of about 50 degrees A. P. I. is used the product has a gravity of 56 degrees or 57 degrees A. P. I., and is pumped directly to the gasoline storage. A gas oil of about 35 degrees A. P. I. may be used as an absorbent and the gasoline subsequently removed by steam or fire distillation. The stripped gas oil is returned to the absorption plant and used again.

In most absorption plants treating refinery vapors, the gases are collected by an exhauster which discharges under enough pressure to force the gas through the absorption tower. These towers differ greatly in size because of differences in the volume of gas to be treated and the pressure on the gas.

Absorption in Naphtha

In one plant where naphtha having a gravity of 50° A. P. I. is used as the absorbent, five 10 by 30 foot towers are employed for treating about 1,000,000 feet of gas daily. These towers have steel baffles and cone plants, the baffles containing 22 circles of 5-inch holes drilled 2 inches apart.

The gas enters the bottom of the first absorber, discharges at the top, passes to the bottom of the second absorber, and so on through the series. Pumps keep the naphtha moving countercurrent in each absorber until the gravity in the last absorber has reached the point desired. Then the blend from this tower goes to storage and the naphtha from each tower moves to the next tower, where the same process is repeated.

In another method of absorption which is more generally used the gas and naphtha flow countercurrent through a series of towers. This method has the advantage over the method previously described in that the naphtha is handled only once and at its discharge has the gravity desired, but the method has peculiar difficulties not experienced in the first type of plant, for the gasoline content of the gas being treated varies widely and in consequence the rate of flow of the naphtha must be watched carefully to insure a uniform product.

Absorption in Gas Oil

An absorption plant using a gas oil as absorbent resembles the absorption plant of the natural-gas gasoline industry rather than a naphtha-absorption plant.

The use of gas oil as an absorbent entails such additional expense for removal of the gasoline; the use of naphtha does not, because when the gravity is raised to the desired point the product can be pumped directly to the gasoline storage. In refineries where gasoline can be recovered from the gases naphtha absorption is probably the more advantageous; the factors of price and transportation do not have to be considered, and the gases treated are much richer in higher hydrocarbons than is natural gas, which contains only a small percentage of gasoline vapor. As the uncondensed still vapors carry so much gasoline, their absorption in naphtha is much more efficient than is the absorption of gasoline from natural gas. At a refinery using naphtha absorption the naphtha is cut from the crude stills and after passing through the absorption system is pumped to the straight-run gasoline storage. The

RECENT REFINERY PATENTS ISSUED

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the refining industry were issued during April:

No. 1,489,905, issued April 8 to Otto Stalmann, Salt Lake City, Utah: A retort, consisting of the combination with a tubular body, of means for charging material into its upper end and maintaining it closed; a rotatable material support at the lower end of the body, means of rotating the support, a receiving trough about the periphery of the rotatable support, means for directing the spent material to the trough from the support, menas for permitting the discharge of the spent material from the trough while maintaining the same closed against ingress of air, and means for introducing steam into the body.

No. 1,490,055, issued April 8 to Francis Sales Woidich, Sapulpa, Okla.: A process and apparatus for distilling oil, consisting of a continuous process of distillation which comprises heating while in continuous flow crude oil containing light hydrocarbons to a distillation temperature, separating the unvaporized oil from the vapors, subjecting the hot vapors to prolonged, intensive and intimate contact with each other and the reflux liquid while passing upward through a tower provided with filling material having an extensive contact surface, and then recovering the several fractions from the complex mixture of hydrocarbon vapors by fractional condensation.

No. 1,490,213, issued April 15 to James B. Jenson, Salt Lake City, Utah: A process for treating oil shale to produce oil therefrom, which consists of subjecting the shale to various degrees of heat while it is passing through coacting individual chambers; condensing the vapors of each chamber in another separate chamber; again volatilizing the condensate of some of said separate chamber by bringing it into contact with the shale under treatment in the chamber of highest temperature to carry off with the spent shale any particles of fixed carbon or other solids resulting from the operation.

No. 1,490,462, issued April 15 to Harrison M. Gill, Taft, Calif.: A gas, oil and sand separator comprising an initial closed vessel for receiving the mixture of gas, oil, sand and water as it comes from a well and settling out therefrom the sand and water; a second closed vessel to the upper and lower areas of which the gas and oil from the initial vessel are respectively separately delivered; and means within said second vessel for automatically, reciprocally controlling the separate discharge of the gas and oil therefrom according to the proportions of gas and oil entering said vessel.

No. 1,490,463, issued April 15 to Harry Groves and David E. Lain, Bellingham, Wash.: An oil-shale distillation apparatus; in a retort comprising two circular, concentric, vertical shells with an intervening retort chamber, the combination of said retort shells; a plurality of pipes connected to said inner shell leading from said chamber; a plurality of pipes connected to said outer shell leading into said chamber, said pipes connected to said chamber at vertically spaced locations in staggered relations; and means whereby hot gas is caused to flow through said pipes connected to one shell transversely through said retort chamber and among broken shale therein and into and through said pipes connected to said other shell.

No. 1,490,862, issued April 15 to Vergil T. Smith, San Francisco: A process for distilling and cracking oils which consists in causing the oil to descend into a bed of combustible carbonaceous material heated by burning the same at the bottom and increasing in temperature toward the bottom whereby the oil is vaporized and in guiding the vapors so produced laterally through a bed of combustible carbonaceaus material heated by burning the same at the bottom and maintaining a constant temperature in the direction and path of flow of the vapors for cracking the same.

No. 1,490,945, issued April 22 to William R. Smith, Buffalo, N. Y.: An apparatus for separating oil from oil shale, comprising, in combination, a vertical retort having an inlet for crushed material at its upper end, and an outlet for residuum at the lower end, air-excluding feeding means for delivering material to said inlet, and permitting the material to fall in a vertical stream through the retort, the said outlet being formed to deliver residual matter in the form of a moving plug, which prevents the entrance of air into the retort through the outlet, heating means within the retort in the path of said stream, organized to act on the falling material and cause destructive distillation thereof, a condensing conduit for the volatilized products of distillation, communicating with the upper end of the retort, means for condensing the volatilized products in said conduit, and a pump connected with the conduit, and adapted to maintain a constant suction in the retort and the conduit, and to force the condensate to a receptacle.

No. 1,491,290, issued April 22 to David J. L. Davis and George W. Wallace, New York, assignors to S. E. Company of Delaware: An apparatus for extracting oil from shale, by internal combustion, comprising an upright closed chamber, a removable bottom closure for said chamber consisting of an oil receptacle having a lateral outlet and a grate covering said receptacle, and means to move said bottom closure laterally away from the chamber to discharge the contents of the latter, the edge of the closure being adapted to make a tight fit against the bottom of the wall of the chamber.

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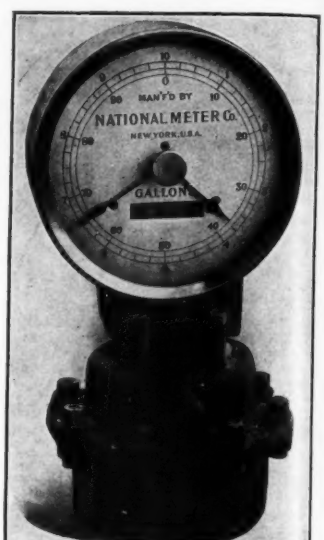

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More Than Half of Mid-Continent Plants Shut Down on May 1—116 Now Operating

Tulsa, Okla.—Out of a total of 240 refineries in the Mid-Continent section of the United States, there are, at the present time, 124 shut down.

The combined capacity of these 240 refineries is 752,310 barrels, but the 116 plants which are running have a daily output of only 403,630 barrels. This amount can be compared with the daily runs of last December and other mid-winter months.

Assuming that some of the plants are shut down for repairs, the fact remains that more than half of the refineries in the Mid-Continent are shut down on account of the excessive amount of gasoline in storage, combined with the fact that demand is small, brought about by a late spring.

In Oklahoma where there are 54 plants shut down compared to a total of 49 running, the total daily output of gasoline is 224,600 barrels, with a total capacity of the 103 plants standing at 353,900 barrels. The Sinclair refinery at Cushing, which has heretofore been running about 6,000 barrels per day is among the largest of plants to cease operations during the month of April. This plant has a daily capacity of 8,000 barrels.

Mid-Continent Refinery Runs By Tabulation

(As of May 1, 1924)

	No. of Plants	Capacity	No. Running	No. Shut Down	New Running
Oklahoma	103	353,900	49	54	224,600
Kansas	39	117,200	21	18	61,580
North Texas	60	178,200	28	32	70,360
Louisiana	15	48,650	6	9	24,800
Arkansas	18	36,960	9	9	14,390
Missouri	5	17,400	3	2	7,900
Totals	240	752,310	116	124	403,630

The largest daily output in the state of Oklahoma is the run of the Cosden and company refinery at West Tulsa, which is running approximately 18,000 barrels per day. The capacity of this plant is 35,000 barrels per day. The Texas Company refinery, also at West Tulsa, with a capacity of 8,000 barrels, is running at full capacity as likewise is the Marland refinery at Ponca City, which has a capacity of 12,000 barrels per day. There are few of the smaller refineries running within the state, only 14 in fact, with a capacity of less than 2000 barrels. The Sapulpa Refining Company refinery, which was recently acquired by the Mutual Oil Company, and which has been shut down for some time, is now running 2500 barrels per day.

In Kansas, the situation is much like that in Oklahoma, there being 18 refineries out of a total of 39, shut down. Of the total of 61,580 barrels being run daily in the state, the Skelly Oil Company plant at Eldorado is running approximately 10,000 barrels, the Roxana Petroleum Company plant at Arkansas City is running 8000 barrels and the Sinclair refinery at Argentine is running 8000 barrels, which means that these three plants are running almost one-half of the entire output of the state.

The 28 refineries in North Texas which are running at the present time, have a combined daily output of 70,360 barrels, only about 10,000 more barrels than was being run in the midwinter months. Reports show that only three more plants are shut down now than were shut down during that time, indicating that North Texas is holding it's own against probable adversities in the industry.

The Mexia Oil and Refining Company refinery at Corsicana tops the list of running refineries, it having a daily run of approximately 10,000 barrels, while the Texas Company refinery at Dallas is running 8000 barrels daily. The capacity of the Texas Company refinery is 15,000 barrels per day.

With five refineries running in North Louisiana, the total daily output is 24,800 barrels, about the same amount as was being run last December. The Louisiana Oil and Refining Corporation refinery at Gas Center leads the list of Louisiana plants with an average daily run of 7000 barrels. The Caddo Central Oil and Refining Company, with two plants at Cedar Grove, is running 7600 barrels daily from both plants.

Arkansas is only utilizing about one-third of its refinery capacity, there being only 14,390 barrels being run

---

only expense involved is that of pumping.

Economics of Recovery

As shown previously, certain factors are responsible for the noncondensation of gasoline vapors, and the question arises whether in attempts to reduce the loss it will be more economical to change plants already built than to install a plant for recovering the vapors as gasoline. A recovery plant is in reality a secondary condensing system—an auxiliary to the primary condensers. This means that if temperature of the gas from the condensers could be kept low enough the recovery plant would be of small advantage.

Maintenance of a low temperature in the gas stream, however, depends on cold water and a large condenser area. Loss of gasoline due to the high temperature of the stream raises an economic problem—whether enlarging the condensers, obtaining colder and larger supplies of water, or building a secondary condensing system in the form of a compression or absorption plant would be least expensive.

The quality of the crude must also be considered, for if the crude contains only a very small proportion of the lighter hydrocarbons, condensers that are too small and not cooled enough to handle the large volume of light vapors from a high-gravity crude can handle the small volume of vapors from a low-gravity crude.

Plants having pressure stills in operation offer another problem, for the gases formed in cracking are permanent and can never be recovered as gasoline. In a cracking process where the pressure is not released until the vapors have passed through the condensers, all of the gasoline vapor worth recovering is condensed and the uncondensed gas remaining has so low a gasoline content that its treatment need not be considered. In a cracking process where the distillates condense at atmospheric pressure the condensation of the very light vapors depends entirely on the condenser area and the temperature of the cooling water. Another feature to be noted in considering the installation of a recovery system is that by lines run to storage tanks containing crude oil and gasoline large quantities of vapor can be recovered that would otherwise evaporate and be lost. It is well known that a high percentage of gasoline and crude oil in storage is lost through evaporation, and that the part which evaporates from crude represents the most volatile and most valuable fractions.

At plants already in operation it is obviously much cheaper to install a compression or absorption plant for condensing the gasoline as a vapor than to enlarge condensers, especially where cold water is scarce. Probably no other expenditure in a refinery will give a quicker return than that required for a recovery plant. One refinery, for example, paid for the recovery plant by operating two months. This could not be done in every refinery, but if all the factors mentioned are considered before the plant is installed, appreciable quantities of gasoline can undoubtedly be saved.

throughout the 18 refineries in the state, however, nine of the 18 plants are shut down, but those running are far under their capacity.

The Lion Oil and Refining Company plant at Eldorado is the largest refinery running at the present time. The reports show this plant to be running 7000 barrels per day, almost half of the gasoline that is being refined in the state. The Farmers Oil and Refining Company plant at Texarkana, which has been shut down for some time, is again running with a daily output of 200 barrels per day.

Kentucky Concern Buys Refinery at Grandfield

Tulsa, Okla.—The Superior Oil Corporation of Lexington, Ky., has purchased the refinery at Grandfield, Oklahoma, of the Grandfield Oil and Refining Company. The refinery is rated at 2,500 barrels capacity.

New Output Record on Gasoline During March

The gasoline refiners of the country continue to set new records in the production of this commodity, the output in March amounting to 743,248,292 gallons, which surpasses by 48,000,000 gallons the previous high record established in January, states the Department of the Interior. Statistics collected by the Bureau of Mines show also that a new high record in gasoline stocks was attained on April 1, when 1,571,404,667 gallons were on hand at refineries. The figure represents an increase of practically 200,000,000 gallons over the former record of 1,374,000,000 gallons made on March 1. Production of gasoline in March of this year shows a daily increase of 3,630,546 gallons, or 17.8 per cent, over the March, 1923, figures, and a daily increase of 605,396 gallons, or 2.6 per cent, over the figures for February, 1924. These figures are indicative of the normal annual trend in the production of gasoline during winter months, the output during this period being generally in excess of the consumption in order to provide large storage reservoirs to supply the country during the summer motoring season.

Domestic demand for gasoline during March is reported by the Bureau of Mines as 462,020,385 gallons, an increase of 3.5 per cent over the figures for March of last year, and an increase of 6 per cent over the figures for February, 1924. Exports of gasoline decreased 18,455,988 gallons as compared with the exports for the previous month.

The production of kerosene in March amounted to 200,038,627 gallons, an increase of 9,337,351 gallons over the corresponding month a year ago. Stocks showed an increase of 61,668,391 gallons over the previous year's figure, the total stocks on hand at the refineries April 1 being 345,008,197 gallons. This is an increase of 28,257.978 gallons during the month.

The output of gas and fuel oils for March was 1,114,411,725 gallons as compared with 970,891,272 gallons in March, 1923, an increase of 143,520,453 gallons. Stocks decreased 41,047,486 gallons during the month.

The production of lubricants during the month was 101,126,865 gallons as compared with 90,745,095 gallons during March a year ago. Stocks decreased 4,401,199 gallons during the month. total stocks on hand at the close of March being 251,287,274 gallons.

During the month of March 258 refineries reported to the Bureau of Mines as operating, showing an aggregate daily crude oil capacity of 2,169,282 barrels, running to stills a daily average of 1,749,370 barrels of both foreign and domestic crude oil, or at the rate of 80.6 per cent of their daily capacity.

Mutual Takes Over Plant Of Sapulpa Refining Co.

Denver, Colo.—Acquisition by the Mutual Oil Company of the modern refinery and pipe line gathering system of the Sapulpa Refining Company at Sapulpa, Oklahoma, gives the Mutual a refining foot-hold in the Mid-Continent where the company already is firmly established in the producing end. The Sapulpa plant has been acquired on an exchange of stock transfer, the basis being one share of Mutual for five of Sapulpa Refining.

The Sapulpa Refining Company's plant is rated at 6,500 barrels capacity and is a complete plant.

The Mutual now is operating the plant and has just taken over from Cosden and Company of Tulsa, that company's six-inch line from West Tulsa to Sapulpa. Mutual has acquired through development and purchase considerable production in the country club pool district near the city limits of Tulsa. The company also has production in other sections of the Mid-Continent.

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COMPRESSION and Absorption Gasoline

Swift Shipments from

OKLAHOMA

TEXAS LOUISIANA

We make and market all grades of natural gasoline. You can get what you want, right on the dot, when you entrust your order to Akin.

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Exchange National Bank Building

TULSA :—: :—: OKLAHOMA

Making gasoline in your refinery is merely a means for making money If you are indifferent to the financial results, then you can afford to be indifferent to the means for producing your gasoline, but if not, the Dubbs Cracking Process, and the Dubbs Process only, will produce the ultimate amount of gasoline obtainable from each barrel of crude run through your refinery at the lowest cost and consequently obtain the greatest profit per gallon

This is a fact, capable of proof, and we are prepared to prove it to you

Universal Oil Products Company
Owners of the Dubbs Process
312 South Michigan Ave
Chicago Illinois

Texas Natural Gasoline Shipments Show Over a Third Gain During Three Months

Fort Worth, Texas.—Shipments of natural gasoline from the various manufacturing centers in North and Central West Texas during the first three months of this year represent a gain of approximately 34 per cent when compared with the aggregate total for the corresponding months in 1923, while a new high record for natural gasoline shipments from Texas plants was established this past March with a total of 18,393,690 gallons for the month. Shipments of this blending product during January, February and March from Texas amounted to 53,335,044 gallons, while the total shipments during 1923 amounted to 185,845,548 gallons. These figures indicate the magnitude of the natural gasoline industry in Texas alone, and its importance as one of the sources of supply for the Nation's motor fuel needs.

Natural gasoline shipments from Texas plants have been gradually increasing since the introduction of the industry into the state more than six years ago, and indications are favorable for further increases over the present year, as a few more plants are under construction in Eastland and Stephens Counties while several old plants in these two counties are being enlarged. Most of the desirable gas production in the state is being stripped of its gasoline contents as result of the extensive plant building programs conducted by the various gasoline manufacturers in recent years, and new construction work from now on will depend on the development of additional gas production. Considerable drilling is now underway in some of the "wet" gas areas in Central West Texas, and gasoline manufacturers are offering to contract for new plants as the additional gas becomes available.

Although the gas production in the old fields in the state is taking its natural decline, the rate of depletion has not been as great as was originally predicted. This decline in gas pressure has been followed by an increase in gasoline yield from many of the wells, thereby making it possible for the plants to maintain their output and handle less gas through their machinery.

Shipments of natural gasoline from the various manufacturing centers in Texas during the first three months in 1924 follows:

Fields—	Jan.	Feb.	Mar.
Ranger-Eastland-			
Pioneer	126,740	112,115	135,115
Stephens County	103,350	100,746	118,365
Desdemona-Gorman ..	91,885	80,275	81,285
Burkburnett	62,390	62,150	57,205
Electra	19,540	17,856	21,245
Young County	10,105	11,930	7,810
Shackelford County ..	11,005	7,685	10,240
Petrolia-Clay County	5,645	4,810	4,850
Amarillo-Potter County	1,200	1,030	1,500
Totals in Bbls. 42 gals.)	433,020	398,917	437,945

industry into the state more than six

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No job too Small

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North American Car Co.
327 S. LaSalle St., Chicago

Southwestern District Office:
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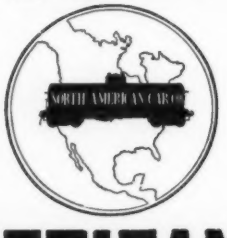

NORTH AMERICAN CAR CO.

LESSORS OF TANK CARS

Empire to Enter Burbank With Big Gasoline Plant

Bartlesville, Okla.—The Empire companies have announced plans for the construction of a natural gasoline plant in the Burbank field, in Osage County, Okla. The plant will be located on the southwest quarter of 12-27-5, a little to the north of tracts Nos. 308 and 626, of the Empire companies.

Material for the construction of the plant has been arriving the past several days and breaking ground will start immediately. The plant is expected to be completed some time in July.

The announcement of the Gasoline division of the Empire companies to enter the Burbank field is a continuation of the policy of this concern to establish another branch of its operations in the Osage. The Gas division enlarged its activities in the field when it completed the gas line between Burbank and the newly constructed Cambridge compression station. The Oil Production division became a more active operator in this field with the purchase of two important tracts, and now a pipe line, extending from the Burbank field to an Empire refinery at Ponca City, is under construction in addition to its previous pipe line extensions in this field.

TOP NOTCH GASOLINE

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We have again resumed operation of our Sand Springs Refinery, and solicit your inquiries.

New Navy Gasoline **32-36 Light Straw Gas Oil**

Low Cold Test Fuel Oil

Chestnut & Smith Corporation

General Offices: Chestnut and Smith Building, Tulsa, Okla.

Also Natural Gasoline in any Grade to suit your need:

Tear this out and put it underneath the glass on your desk or other place for ready reference.

GRADES OF NATURAL GASOLINE
Manufactured by
CHESTNUT & SMITH CORP.

GRADE "A"	GRADE "B"	GRADE "C"
Gravity..... Not below 72°Be. Not above 78°Be.	Gravity..... Not below 76°Be. Not above 82°Be.	Gravity..... Not below 80°Be. Not above 88°Be.
E. P.....Not over 375°F.	E. P.....Not over 375°F.	E. P.....Not above 350°F.
Recovery....Not less than 90%	Recovery....Not less than 85%	Recovery....Not less than 78%

GRADE "D"	GRADE "1"	GRADE "2"
Gravity..... Not below 88°Be. Not above 92° Be.	Gravity..... Not below 58°Be. Not above 62°Be.	Gravity..... Not below 58°Be. Not above 62°Be.
E. P.....Not above 350°F.	E. P.....Not over 437°F.	E. P.....Not over 450°F.
	Recovery....Not less than 91%	Recovery....Not less than 90%

GRADE "3"	GRADE "4"
Gravity..... Not below 64°Be. Not above 66°Be.	Gravity..... Not under 66°Be. Not over 70°Be.
E. P.....Not over 440°F.	E. P.....Not over 435°F.
Recovery....Not less than 88%	Recovery....Not less than 85%

Natural Gasoline

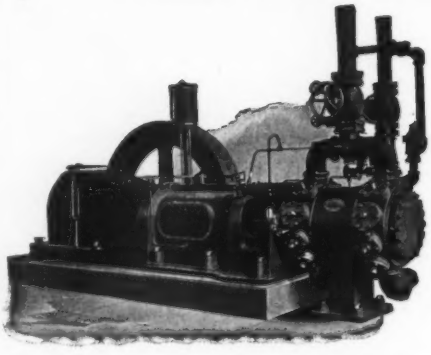
Bureau Wants Better Service of Reports

A number of companies in the petroleum industry have suggested to the Department of the Interior the desirability of having the Bureau of Mines collect by telegraph, on the first of each month, statistics showing the stocks of gasoline on hand at that time, and the prompt dissemination of this information by the bureau to the industry. This plan has been proposed to meet the need of the industry for reasonably accurate, but very prompt and up-to-the-minute information. It has been suggested that if this information had been collected during the year 1923 it would have aided in the improvement of trade conditions. The impression appears to exist that gasoline stocks are a good barometer of the situation from the refiner's standpoint and, if such figures could be compiled and given out shortly after the close of each month, a valuable service would be rendered the petroleum industry.

The Bureau of Mines is anxious to be of maximum service to the petroleum industry, and is willing to compile these figures each month if there is a real demand for information of this kind. Unless the refiners are willing to cooperate by promptly telegraphing the figures at their own expense, it would not be worth while attempting the experiment for, unless the totals include a major portion of the stocks on hand, the figures would be of little value. It is to be understood that the Bureau of Mines will continue to collect figures and prepare reports each month on the output and stocks of all refinery products, including gasoline. It is impossible, however, to get this report much earlier than at present, due to the fact that a number of the refiners can not submit complete statements until the 15th or 20th of the month following the period covered by the statistics.

The Bureau of Mines has addressed inquiries to the different petroleum refiners asking if they would be willing to telegraph the bureau the figure for gasoline stocks within two or three days after the close of each month, and, if so, whether the figures could be furnished on the first of May.

Vilter Ammonia Compressors Fittings and Pipe Coils
Render Years of Reliable Service



Compressors built in several types and a great variety of sizes. Illustration is of a high speed type compressor.

Complete Data on Request

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Texas Gasoline Plant To Use Charcoal Method

Breckenridge, Texas.—The charcoal process for manufacturing natural gasoline is being installed by the Landreth Gasoline Company of Breckenridge to be used in conjunction with its mineral seal absorption plant in the Ibex field, Shackelford County, and plans are to have the charcoal unit in operation before July 1. This is the first attempt made to introduce the charcoal process on a commercial scale in Texas, and the results obtained by the Landreth Gasoline Company in operating the new process with residue gas from its big mineral seal absorption plant will be watched with interest by natural gasoline manufacturers throughout the Mid-Continent district.

Since the charcoal method of extracting gasoline is credited with having a greater recovery from gas than either the absorption or compression processes, it is claimed that the annual waste of gasoline in residue gas from existing plants in the Mid-Continent manufacturing centers can be materially reduced and additional profits made by the manufacturers by installing charcoal processes to handle the residue gas. The charcoal unit being installed by Landreth will represent an investment of approximately $50,000, and will have sufficient capacity to handle the 50 million cubic feet of residue gas now available. Except for the installation of the three groups of absorbers, or stills, and additional cooling coils, only a small amount of equipment is needed to handle the residue gas with the charcoal process. About 40,000 pounds of activated charcoal, which is made from cocoanut shells, has been ordered for the proposed plant.

A detailed article on the uses and limitations of the charcoal process by G. G. Oberfell and R. C. Alden was published in the November, 1923 issue of the REFINER & NATURAL GASOLINE MANUFACTURER.

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CAST STEEL GATE VALVES

Reading Cast Steel Gate Valves are built for high temperature work, particularly. The flexible construction and suspension of the disc and the method of setting in and backing up the seat ring provide for keeping the valve tight when expansion begins. The steel you are familiar with in Reading Fittings.

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An Associate Company of the American Chain Co., Inc.
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NORVELL-WILDER Hardware Co., Beaumont, Houston, Mildred and Shreveport.
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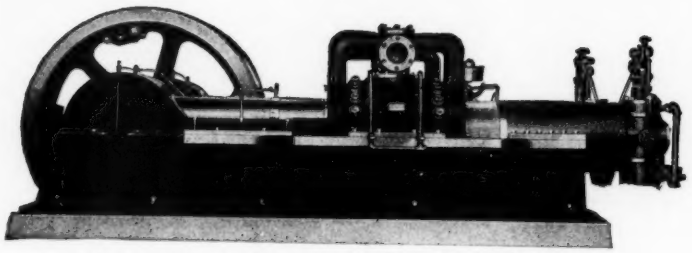
Colonel Byllesby Dies

Chicago, Ill.—Col. Henry M. Byllesby, chairman of the board of the Shaffer Oil and Refining Company, and one of the best known public utility managers in the country, died at his home here April 30. He had been active in the oil business for a number of years as well as directing large public utility enterprises in various sections of the country.

THE NEW ENCLOSED TYPE



Direct Gas Engine Driven Vacuum Pump, Two Cylinder

Watts-Miller Gas Engines and Direct Gas Engine Driven Compressors and Vacuum Pumps

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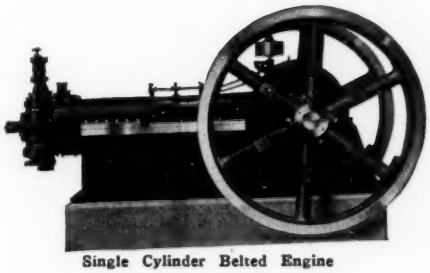
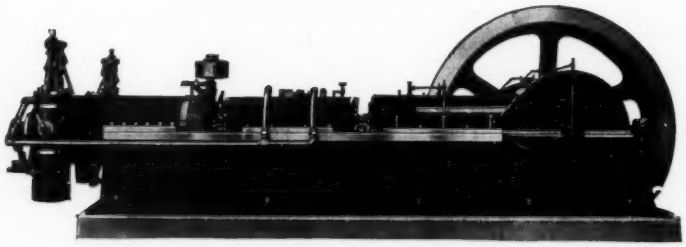
High Efficiency Gas Engines, Compressors, and Vacuum Pumps for Power Plant Equipment

Sizes from 50 to 400 h. p.



Single Cylinder Belted Engine



Direct Gas Engine Driven Compressor, Two Cylinder, Single or Two Stage

Compressors particularly adapted to casing-head gasoline plants, gas pumping plants, and compressed air installations, in single and 2-stage machines to operate on practically all intake and discharge pressures. Continuous circulating filtering automatic oiling system.

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Compact — Efficient — Flexible

Dimensions — overall, 30" x 30" x 9'-0"
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ASSISTANT CHIEF CHEMIST wanted immediately for large up-to-date Refinery near Mid-Continent field. Must be college graduate with experience of testing petroleum products and general analytical work. Initial salary will under no circumstances exceed $175.00 per month. Young man preferred. Must be willing to come to Southeast Kansas for personal interview at own expense. Write giving full particulars including age, details of education and experience, and list of references to Box No. 203, care Refiner and Natural Gasoline Manufacturer.

Doherty Makes Product With New Type Process

Bartlesville, Okla. — The by-products of a new petroleum unit now being constructed for Empire Refineries, Inc., a subsidiary of Cities Service Company, will be marketed under a patent agreement by the Chemical Products Division of the Standard Oil Company of New Jersey, according to an announcement made yesterday by Henry L. Doherty & Company.

The work of building the new chemical products plant of the Doherty organization which will be a part of the Empire Refinery at Okmulgee, Okla., is being done by engineers of the Doherty Research Company. It will be one of the only two plants of the kind in the petroleum industry and the marketing arrangements are an interesting result of conclusions reached when the research divisions of two big organizations had worked along parallel lines but independent of each other.

The evolution of apparatus and the perfection of processes used in this generally neglected branch of the petroleum industry by the Standard Oil Company of New Jersey and the Doherty engineers were so similar that when patent interferences developed, it was deemed advisable to combine patent interest. The patents are now held by a trustee for the use of both companies.

The new plant at Okmulgee will recover alcohols from what have formerly been by-products or waste products of the petroleum industry. The technical names of these alcohols are isopropyl, secondary butyl, amyl and hexyl, the first named having been found superior to grain alcohol for some purposes. It is used among other things in the manufacture of drugs, cosmetics and flavoring extracts. Butyl, amyl and hexyl alcohol are used as solvents in the manufacture of varnishes, lacquer, aeroplane dopes and for practically the same solvent purposes that commercial butyl, amyl and fusel oil are now used. The petroleum by-product alcohols from the new processes, however, have a different chemical content.

These new alcohols are made chiefly from fixed gases at petroleum refineries and have heretofore been burned as fuel under stills and boilers.

The Standard Oil Company of New Jersey is operating a similar plant at its Bayway, New Jersey, refinery.

The manufacture of chemical products is not a new industry for the Doherty organization. For many years the Denver Gas and Electric Light Company, which is now a part of the Public Service Company of Colorado, one of the principal public utility subsidiaries of Cities Service Company, has been manufacturing coal tar products from tars obtained in the usual coal and water gas process.

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Channels, Angles, Roofing, Burner Pipes, etc. We are specialists in Carbon Black Building Material. Most of the buildings in Monroe, La., gas field and Stephens County, Texas, came from us.
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The Advantages of Thermit Welding for Pipe Lines and Coils

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It eliminates leakage.

The joint becomes a point of strength—the pipe line a continuous length of homogeneous metal.

The many other advantages are described in our **Pamphlet No. 1628** which will be sent you on request.

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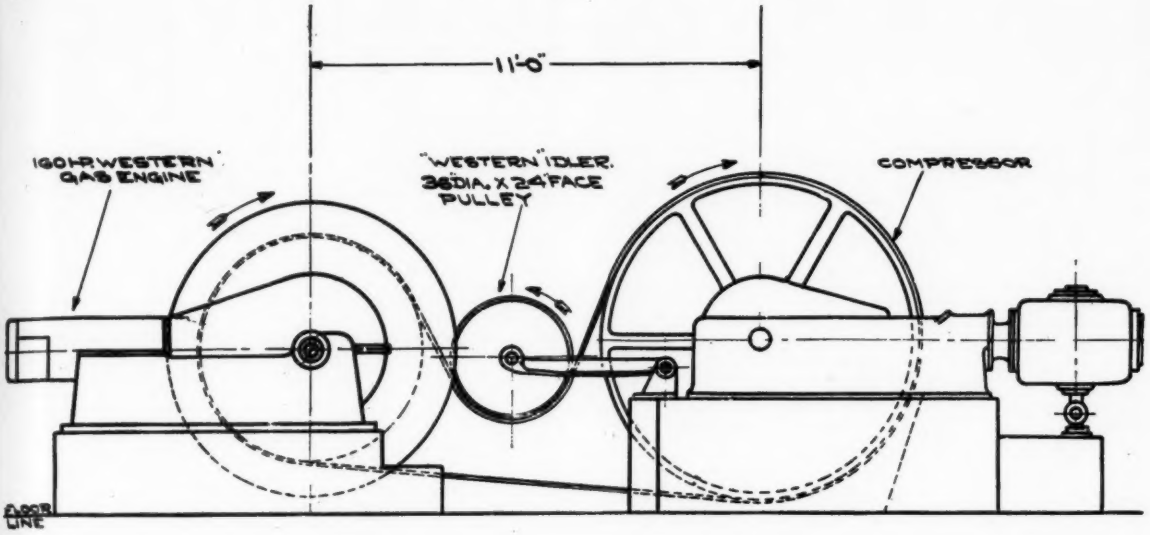

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The "Western" Standard Drive, shown in the drawing above, is a very advantageous hook-up for compressor service, and when used in connection with "Western" Duplex Gas Engines and "Western" Type "SD" Idlers, gives maximum results.

"Western" Duplex Gas Engines and Type "SD" Idlers embrace the efficiency and DEPENDABILITY SO NECESSARY IN COMPRESSOR SERVICE.

A few Purchasers of Recent Date:

Pan American Petroleum Co.	36 units
Skelly Oil Co.	12 units
General Petroleum Corp.	6 units
Midway Gas Co.	36 units
Shell Co.	12 units

United Oil Co., Los Angeles Gasoline Co., Long Beach Gasoline & Refining Co., and others.

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Refiners' Supplies

		May 5
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Silicate of Soda 60 deg. bbls.	cwt.	1.70
Sal Soda wks	cwt.	1.10–1.25
Caustic Soda 76%	cwt.	3.10
Chloride of Lime solid	cwt.	1.90–2.10
Sulphuric Acid 60 deg. tank cars f. o. b. shipping point	per ton	9.00–10.00
Benzol—		
Pure Water White Tanks	gal.	.25 —.30
Drums	gal.	.30 —.35
90% Tanks	gal.	.23 —.28
Drums	gal.	.28 —.33

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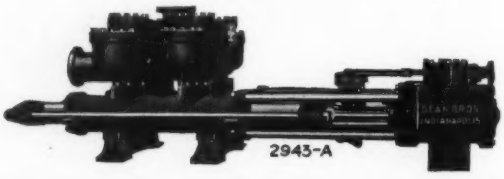
INDIANAPOLIS.

OIL PUMPS
For Hard Continuous Service

The pumps will not short stroke. Are substantially and carefully built. Have large and free passages which do not restrict the flow. Extremely economical in the use of steam.

Send for Catalogue.



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WHAT'S in a name, anyway? The refinery construction work we are doing under the name "Pioneer" is just the same high grade as when it bore the name "Tulsa Boiler and Sheet Iron."

For eighteen years, as the "Tulsa Boiler and Sheet Iron Works" we have turned out tanks and refinery steel construction that made good friends for us among the wise buyers of the Mid-Continent. We pioneered in giving these people "close to home" service on the best kind of work.

Now, under the new name, The Pioneer Tank and Boiler Company, we're all set with the men, machinery and money to keep on growing under the Pioneer banner like we did when Tulsa Boiler and Sheet Iron was on our letterhead.

There is no change in our organization.

Get Pioneer quotations on tank and refinery construction work.

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Jobbers' Supplies

Vegetable Oils—		
*Linseed, carloads Spot	gal.	.90—.91
March	gal.	—.90
Less carload Spot	gal.	—.95
5 bbls. or less Spot	gal.	—.98
Boiled, tank Spot	gal.	—.88
Boiled, carloads Spot	gal.	—.94
Soya Bean Spot, Tanks	lb.	—.10½
Animal Oils—		
English Degras	lb.	$-.04¾
Domestic Degras, bbls., carloads	lb.	-.04¼
Horse	lb.	.08
Oleic Acids—		
Dist.	lb.	-.09½
Saponified	lb.	-.09½
Lard Oils—		
Prime Winter Strained . . 1 to 1½ ffa. 40/45c t.	lb.	.13¼
Extra Winter Strained 2 to 4½ ffa. 40/45c. t.	lb.	12¼
Extra 4 to 5 ffa. 40/45c. t.	lb.	11¾
Extra No. 1 7 to 10 ffa. 40/50c. t.	lb.	.11¼
Extra No. 1 15 to 18 ffa. 40/50c. t.	lb.	.10¾
No. 2 22 to 23 ffa. 40/45c t.	lb.	.10½
Prime Edible Tallow under 1¾ ffa. 40/45c t. N. Y.	lb.	.08½-.08¾
Tallow acidless	lb.	—.11¾
Lard Stearine	lb.	—.13¾
Oleo Stearine	lb.	—.10¾
Neatsfoot Oil—		
Pure	bbls.-lb.	—.14¼
Extra	bbls.-lb.	—.11¼
No. 1	bbls.-lb.	—.10¾
Cold pressed	lb.	—.18¼
Fish Oils—		
Menhaden Oil Light pressed	gal.	-.60
White	gal.	.65–67
Yellow bleached	gal.	.63–.65
*Herring, tankcars coast	gal.	-.50
Whale, extra winter bleached	gal.	-.81
Seal		Nominal
Naval Stores—		
Turpentine, N. Y.	gal.	.91
†Turpentine	gal.	.85
Rosin B. N. Y.	bbl.	5.50
Rosin F. N. Y.	bbl.	5.80
Rosin B.†	bbl.	4.40
Rosin F.†	bbl.	4.60
Rosin Oil 1st run	gal.	.43
Rosin Oil 2nd run		.47
Pine Tar—		
Kiln Burnt	Bbl.	11.00
Retort	Bbl.	11.00

*Nominal
†Savannah, Ga., market.

Louisiana Company May Build Plant in Oklahoma

Shreveport, La.—The National Gasoline Company of Shreveport is contemplating the erection of a natural gasoline manufacturing plant in the Wewoka, Oklahoma, field, and a sufficient amount of gas has been contracted for from the Dixie Oil Company to operate a 10,000,000 cubic foot daily capacity plant. The proposed plant is to be equipped with the mineral seal absorption process. The National Gasoline Company already has plants in operation in Stephens and Eastland Counties, Texas.

STOP PIPE CORROSION
IN SMALL LINES

Our Simplex Prepared Joint Cast Iron Pipe is made in 2", 3", 4" or 6" diameters. Since it has been available thousands and thousands of feet of this material has been used in the oil fields.

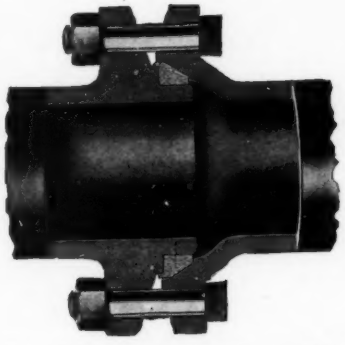

Illustration of section through assembled joint of Simplex Prepared Joint Five-Foot pipe, showing asbestos endless ring gasket in place. This gasket is adapted to use for oil, vapor and acid lines. A rubber gasket is compounded to suit the particular service it is to render—steam, natural gas, artificial gas, water, oil, etc.

Its chief advantage lies in its immunity from corrosion as compared with other ferrous pipe. Its desirability is further increased by the special joint, with only two bolts, and with a thick, endless ring gasket. It is rapidly and easily laid by inexperienced men.

Wherever permanent construction is desired, it is little short of an economic crime to spend money for a pipe line of perishable material when a practically permanent construction can be obtained by the use of cast iron.

Do you know why cast iron withstands corrosion so much better than any other ferrous metal? Our Bulletin No. 44 explains it.

Simplex Prepared Joint Pipe is furnished with a full line of fittings. The material is fully described and illustrated in our Catalog No. 48. Your copy is waiting to be mailed, upon receipt of your request.

American Cast Iron Pipe Company

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York, Minneapolis

Write Also for Information on Our
Simplex Cast Iron Pipe for Oil Condensers

Here's What Happens When Rust Gets A Chance

A tank roof honeycombed with rust holes—evaporation losses many times multiplied—early repairs, if not a gauger drowned, or replacement of the entire roof.

That's why you should paint the underside of your tank roofs.

Back of Degraco Tank Paints stands the integrity of the maker—thirty-five years of close contact with paint problems. A definite knowledge of the service conditions to be met and how to meet them are the basic reasons for their wide and successful use in the oil industry.

You can bank on Degraco Paints to cut down corrosion losses.

(245)

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